THE CHEMICAL POCKET-BOOK,

OR

MEMORANDA CHEMICA;

ARRANGED IN A

COMPENDIUM OF CHEMISTRY,

ACCORDING TO THE LATEST DISCOVERIES,

WITH

BERGMAN's TABLE OF SINGLE ELECTIVE ATTRACTIONS,

AS IMPROVED BY Dr. G. PEARSON.

CALCULATED, AS WELL FOR THE OCCASIONAL REFERENCE OF THE *PROFESSIONAL STUDENT*, AS TO SUPPLY OTHERS WITH A GENERAL KNOWLEDGE OF CHEMISTRY.

BY JAMES PARKINSON.

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PREFACE.

THE following assemblage of chemical facts was formed, with the hope of rendering it an agreeable pocket companion for the lovers of Chemistry in general; and more particularly so for those who may be just engaging in the study of this most useful and interesting science. To the latter the Author hoped it might be more particularly beneficial: like a bird's eye view to a traveller, furnishing a general view of the relation and connection of the several parts of that region, which is soon to become the object of a nearer and closer investigation.

May this little Compendium lead fresh admirers into the delightful walks which are to be found in this department of science; where wide scenes of interest and amusement are constantly opening upon the

the mind. May it point out the indispensible connection between Chemistry and most other sciences, and the vast advantages a knowledge of its principles may yield to those who are engaged in the most useful and profitable arts; and thereby induce those who are not of the medical profession, to seize the opportunity of obtaining fuller information, by the pleasing and expeditious mode of Public Lectures.

The Author can claim but little merit from this humble attempt; he however trusts it will be found void of any egregious faults. He fears that, from an anxiety for brevity, he may sometimes have employed a mode of expression not possessing that degree of perspicuity, which is ever required. From some new discovery having been announced, perhaps, when the parts of the section to which it belonged, had been printed, has proceeded, in one or two instances, such an arrangement of the paragraphs as would have been otherwise avoided. The Diamond will be found to be spoken of under the head of Iron; the reason of which is, that at the time of printing the sheet containing Carbon, under which head this substance might with propriety be placed, such discoveries had been made as promised others still more important. The article Diamond was therefore deferred,

ferred, until these appeared, when they were collected and placed under this head, where they will be perused with peculiar advantage; since the Diamond will thus be viewed in connection with those other substances to which it appears to be allied by the quantity of carbon it possesses.

The spelling of *Gaz* and *Oxyd* was thus adopted in the earlier sheets, on the authority of Dr. *Pearson*; but, according to the opinion of the same gentleman, it was afterwards changed for that of *Gas* and *Oxide*. When the article CORUNDA was printed, *Klaproth*'s second analysis of the Adamantine Spar was not generally known in this country; but this is pointed out in a subsequent part of the work, to which the reader is kindly intreated to refer. The general arrangement, it is feared, may not appear to the critical observer, sufficiently systematical. A reason, in excuse for this, is, however, offered in the beginning of the work.

It is hardly necessary to acknowledge the obligations to the various labours of *Bergman*, *Fourcroy*, *Lavoisier*, *Chaptal*, *Kirwan*, *Pearson*, *Babington*, &c. as they must appear on the face of the work. To the Transactions of the Royal Society; to that excellent periodical publication of Philosophical and Chemical Discoveries, the Philosophical Journal of Mr. *Nicholson*; to the Medical and Physical

sical Journal, and to the Philosophical Magazine, he is also indebted—but his acknowledgments would be endless, since he has endeavoured to obtain aid from all around him. Like the bee, he has roved freely in search of materials—happy shall he esteem himself if he shall faintly have imitated its skill in their selection and arrangement.

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CHEMISTRY.

CHEMISTRY is the Science which discovers the constituent principles of bodies, the results of their various combinations, and the laws by which those combinations are effected.

Chemical inquiries are prosecuted by certain operations or processes; which are performed either by ANALYSIS, or *decomposition*; or by SYNTHESIS, or *composition*. These operations depend on the affinities, or powers of attraction, which act on bodies, and on the elementary parts of bodies.

THE ATTRACTION OF AGGREGATION, is that by which the homogeneous particles of bodies are united. According to the degree of force with which this power acts, are produced, 1. The *hard* or *solid* aggregate. 2. The *soft* aggregate. 3. The *fluid* aggregate. 4. The *aëriform* aggregate. This affinity of aggregation is affected by the action of heat, and by mechanical separation.

THE ATTRACTION, OR AFFINITY OF COMPOSITION, is that by which the heterogeneous particles of bodies are united. The general principles, or laws by which this power acts, are—1. It

acts on the constituent parts of bodies of different natures. 2. It takes place in the inverse *ratio* of the affinity of aggregation. 3. Bodies, immediately on being united by it, suffer a change of temperature. 4. The Compound, thus formed, pos sesses properties differing from those which were before possessed by the bodies of which it is composed. 5. All bodies have their own peculiar affinities with other bodies. 6. The particles thus united, constantly assume a determinate form: the same combination always producing the same form.

The Affinity of Composition is denominated, according to the number of principles it acts upon,

1. *SIMPLE AFFINITY*, or *single elective attraction*, when one of two principles is displaced by the addition of a third.

2 *DOUBLE AFFINITY*, or *double elective attraction*, when two bodies, each consisting of two principles, suffer decomposition, by a reciprocal exchange and union of their elements, by which two new compound bodies are produced.—Mr. Kirwan employs the term, *Quiescent Affinity*, to mark that, by virtue of which, the principles of each compound adhere to each other; and *Divellent Affinity*, to distinguish that by which the principles of one body unite, and change order with those of the other.

The Affinity of Composition is also denominated, from the effects produced,

1. *THE AFFINITY OF AN INTERMEDIUM*, or, that by which one body, in combination with a second, is caused, by the medium of the latter, to unite

unite with a third, which it otherwise would not.

2. *RECIPROCAL AFFINITY*, when a compound of two bodies is decomposed by a third; the separated principle being in its turn capable of decomposing the new combination.

THE ARRANGEMENT of the subjects of Chemistry adopted in this work, is formed on the principle, that no substance should be spoken of in combination, or in illustration of the properties of another, until its own nature and properties have been explained.

SIMPLE or UNDECOMPOSED SUBSTANCES, which, from their more general diffusion through nature, seem to have some claim to the title of *elementary bodies* will, with their less complex combinations, be first described. With the knowledge this will afford, the examination of the various substances peculiar to the vegetable, the animal, and the mineral kingdoms, will be void of difficulty; and although some simple substances will be there met with, which may seem to have deserved to have been noticed in the first part of the work, they will be treated of in the part allotted them, with considerably more advantage, from their being considered, in connection with those substances with which they are combined, and with those natural processes to which they appear to owe their origin.

EARTH is an inodorous, dry, brittle, uninflammable, and generally, tasteless substance; never so-

 luble

luble in less than 100 times its weight of water. There appear to be eight different earths, which may be considered as simple substances.

1. LIME, when perfectly pure, is generally termed Quick-Lime, or pure calcareous earth.—It is white, moderately hard and brittle; its specific gravity, 2,3. —It has a hot burning taste, corrodes animal substances, and changes the Syrup of Violets green. It heats and bursts by the application of moisture, 100 grains absorbing 28,7. of water, becoming *SLAKED LIME*; during which change a degree of phosphoresence may be observed in the dark. It requires nearly 700 times its weight of water to hold it in solution. This solution, which is called *LIME WATER*, has rather an acrid taste, and changes violets green. Except it be mixed with clay, lime is infusible by the greatest heat we know.

2. BARYTES, which has also been termed *Ponderous Earth*, is not found, in a native state, free from combination. When pure it is very fine, white, and resembling lime in some of its properties—It requires 900 times its weight of water to hold it in solution; is discoverable, in most of its compounds, by its high specific gravity; and is not fusible alone.

3. MAGNESIA, is seldom met with, native, in an uncombined state; when pure, it is very light and white. It requires 7900 times its weight of water to hold it in solution. Its specific gravity is about 2,3. Alone, it neither burns nor melts in the strongest heat.

4. ALUMINE, or EARTH of ALUM, is the true argillaceous

argillaceous part of common clay.—It is never found pure, in a native state. When pure, it is white, smooth, and unctuous; diffusible in water, but not more soluble than Magnesia. Its specific gravity, when perfectly dry, is 2,00. When heated, it hardens and diminishes in bulk; but is infusible in the strongest heat of our furnaces. In its usual state of dryness it will absorb 2½ times its weight of water.

5. SILEX abounds in flint, quartz, and mountain crystal. In its usual state it appears insoluble in water; but in a state of division by precipitation, it is soluble in 1000 parts of water.—Its specific gravity is 2,66.—It appears to be incapable of being melted, alone, by the strongest heat that can be applied.

Besides the foregoing more generally diffused Earths, the following are considered as distinct primitive Earths.

6 STRONTHIAN, has not been found pure; when rendered pure by exposure to heat, it is more soluble and specifically heavier than lime. It is visibly precipitated from its solution in water, which, when saturated, yields compressed rhomboidal crystals.

7. JARGONIA or JARGONIC EARTH, found in the stone called Jargon or Zircon, from Ceylon. It resembles Alumine in many respects; its colour is white, and its specific gravity probably exceeds 4,000.

8. CORUNDA, or *Adamantine Earth*, is found in the Corundum Stone from the East Indies. It approaches nearest to the Siliceous earth, but evidently differs from it. Its specific gravity probably exceeds 3,000.

9. GLUCINE has been discovered by Vauquelin in the Beryl, or Aqua Marine. It differs materially from the other earths, and forms salts of a sweetish taste, whence it derives its name.

Other properties of these Earths will be particularised, in that part of the work appropriated to their various combinations.

HEAT, with the various changes produced by it in bodies, is considered, by some, as merely the consequence of certain mechanical changes in bodies; but it is most generally supposed, that these effects depend on a certain matter called *Caloric*, or the *Matter of Heat*.

CALORIC appears to be an highly elastic fluid; and is so very subtile, that neither has its gravity been yet ascertained, nor its existence, in a simple and uncombined state been shewn. It combines chemically with all bodies, in a quantity proportioned to their affinity with it. By its elastic power it constantly tends to separate the particles of matter, in which it is opposed by the attraction of cohesion: Hence, attraction of cohesion predominating, the body exists in a *solid* form: Caloric existing in such a proportion as to weaken the attraction of cohesion to a certain degree, the body assumes a *liquid* form; and when the quantity of caloric is increased still farther, the body takes a *gazeous* form.

It constantly tends to form an equilibrium, by passing from bodies of an higher, and diffusing itself through neighbouring bodies of a lower temperature.

Bodies

Bodies, which thus transmit caloric, are termed conductors of caloric; and according to the power of doing this, they are termed good or bad conductors.

Two bodies of the same nature, unequally heated, on being brought into contact, soon arrive at an equal temperature, the caloric becoming equally divided between them.

But when two bodies, differing in their nature, and differing in the quantity of caloric they possess, are thus allowed to form one common temperature by communication, this will not be found to be an arithmetical mean between the two original temperatures: but the one will be found to have required a greater or a less quantity of caloric than the other, to render it of the common temperature.

This difference of capacity for caloric, or different points of saturation, is supposed to depend on the different degrees of affinity which such bodies possess for caloric. The caloric thus absorbed, is termed *combined caloric*, or in the language of the celebrated Dr. Black, *latent heat*. But when it is perceptible by the organs of feeling, it is termed *free caloric*, or according to Dr. Black, *sensible heat*.

The temperature of a body is therefore higher or lower, according to the quantity of uncombined caloric it thus manifests: and the point at which the mercury in the thermometer rests, when placed in contact with the body, shows the degree of rarefaction or condensation the mercury has suffered, during

during the establishment of an equilibrium, between it and the body to which it is applied.*

The combined caloric may be extricated by external mechanical pressure. Its equilibrium may also be disturbed by a new combination: the new compound, differing in its affinities, not having the same affinity with caloric. Nor is its capacity for heat the mean between the sum of the capacities of its constituent parts, but sometimes greater and sometimes less: Hence, at the instant of union, either its capacity is diminished, and caloric is extricated from the compound, and imparted to the surrounding bodies; or, its capacity is increased, and caloric is attracted from the surrounding bodies, which in the latter case suffer a diminution, and in the former case an increase of temperature.

Bodies passing from a solid to a liquid state, or from either of these to a gazeous form, absorb a portion of heat which becomes *latent*; entering into combination, as one of the necessary constituents of the body, in that state.

Every substance also passing from a state of vapour to that of a liquid, and from this state to the solid state, suffers its combined Caloric to escape, which then becomes *sensible* or *free*.

If

* Mr. Wedgwood invented a pyrometer, made of pieces of prepared clay, to measure the higher degrees of temperature. His scale begins at visible redness, and the extreme heat of a good air furnace of the common construction, is 160° of his scale, or a little more.

If a body be not of a nature to undergo such separation of its parts, by the addition of caloric, as may occasion an alteration of its form, still an increase of its bulk or dimensions, proportionate to its increase of temperature, will take place.

Ice imbibes the caloric communicated to it by other bodies, until it has absorbed sufficient to render it fluid, the temperature of these bodies descending proportionally. From this circumstance we not only derive a proof of the difference of capacity for caloric, in different bodies, but are also enabled to ascertain the relative quantities of caloric they contain. For since equal quantities of caloric will liquify equal quantities of ice, the quantities of ice liquefied by equal quantities of different bodies, will be proportioned to the quantity of caloric those bodies parted with; and will therefore point out the quantities of specific heat they contained, and their respective capacities for caloric.

Count Rumford, from the great quantity of heat produced by friction, is induced to ask, What is heat? Is there any such thing as an igneous fluid? Is there any thing that can with propriety be called caloric? He observes, the source of the heat generated by friction, appears evidently to be inexhaustible; and adds, that any thing which any insulated body, or system of bodies, can continue to furnish, without limitation, cannot possibly be a *material substance*. He concludes it to be almost impossible to form any distinct idea of any thing capable of being excited and communicated in the manner that

that heat is excited and communicated, except it be *Motion*. *Phil. Trans.* 1798.

Heat, Mr. Davy says, or that power which prevents the actual contact of the corpuscles of bodies, and which is the cause of our peculiar sensations of heat and cold, may be defined *a peculiar motion*, probably *a vibration of the corpuscles of bodies*, tending to separate them. It may with propriety be called THE REPULSIVE MOTION. The *non-existence* of caloric, or the fluid of heat, he thinks his experiments have proved.

Dr. Beddoes is also of opinion that most of the phenomena relative to heat, are more easily reconcileable to the *mechanical* than the *chemical* doctrine of heat.

Contributions to Physical and Medical Knowledge, 1799.

LIGHT is an elastic fluid, being reflected from bodies that it cannot penetrate, in an angle of reflection equal to its angle of incidence. It is projected in every direction from radiant bodies, passing through 167000 miles in a second. In its passage near any other substance, it is affected by attraction, and suffers a greater or less degree of inflection. In its passage from one medium into another of a different degree of density, it suffers *refraction*, or a change in its direction. Combustible bodies possess the greatest refracting power.

Solar light is divisible by the prism into seven primitive rays, in the following order ; red, orange, yellow, green, blue, indigo, and violet. It is

lso possessed of chemical affinities, by which enters into combination with other substances; ometimes occasioning their decomposition, and ometimes being itself extricated from its combinaions. It is supposed to yield to vegetables their olour, and to contribute much to their odour, taste, ombustibility, and resinous principle. It also enales vegetables to emit torrents of pure air. In fact, possesses such numerous chemical affinities, that here hardly exists any substance which does not ndergo a change from its presence or absence. ugar, borax, flinty stones, and many other subtances, yield light merely by attrition. Other boies yield it upon being heated: This property has een termed *Phosporism*.

Mr. T. Wedgwood found that the phosphorism f almost all bodies might be made apparent, either y heat or by attrition. By placing them on a plate ade nearly red hot, he obtained a phosphoric light, ot only from different combinations of earths, and ther substances which might be expected to possess his property, but also from pieces of white paper, nen and woollen, hair-powder, sawdust, wax and ils. The light yielded by bodies upon attrition, e conjectures, may be attributed to a sudden heatng (red hot) of particles in their surfaces.

Phil Trans. 1792.

By some it has been doubted whether light is not nerely a modification of caloric, and many connect nem as cause and effect. Some think with Epicus, that this fluid is a continual emanation of the luminous

minous body, which throws to a distance a portion of its substance: and this is the emission of light adopted by Newton. Others, with Euler, think it is diffused throughout infinite space, and is acted on by luminous bodies, as air is by sonorous bodies. Some believe it to be an elementary body, and others confound it with fire. Richter believes it to be composed of the inflammable principle and caloric Prevost has even endeavoured to estimate its gravity.

Dr. G. Pearson describes fire as consisting of caloric and light; and considers light, not as a distinct species of matter, but as a state of caloric, which is manifested by its producing the sensation termed *vision*. *Phil. Journal, and Phil. Trans.* 1797.

Count Rumford concludes from his experiments, that the visible changes produced in bodies by the action of the sun's rays, are effected, *not by any chemical combination* of the matter of light with such bodies, but merely by the heat which is generated, or excited, by the light that is absorbed by them.

Essays on Heat.

Light, Mr. Davy describes, as a body in a peculiar state of existence, *entering into combination with other bodies*, subject to the common laws of matter, and requiring no principles but attraction and repulsion to account for its appearances and changes. The separation of the particles of light he attributes to the *repulsive motion*, eminently predominating over the cohesive and gravitative attraction. He distinguishes this state of existence, peculiar to light, from those of other bodies, by the name of REPULSIVE

SIVE PROJECTION; accounting, for the differently coloured rays, by supposing that the particles of light, in taking the state of repulsive projection, originally received a different repulsive motion.

Contributions to Physical and Medical Knowledge, 1799.

OXYGEN is found only in its combinations, which from its almost universal agency in the operations of nature, are necessarily numerous. It is absolutely necessary to respiration and combustion. Its most eminent property, and that from which its name is derived, is that of forming acids by its combination with certain substances, and which are therefore termed *Acidifiable Bases*.

OXYGEN GAZ is the result of the combination of *Oxygen* with *Caloric*. It exists in atmospheric air, in the proportion of 27 to 100; and is more ponderous than the air of the atmosphere, in the proportion of 45 grains in the cubic foot; its specific gravity being to that of common air, as 1103 to 1000. During combustion it is decomposed, the oxygen is absorbed and fixed by the burning body, which has its weight thereby increased, and its nature changed, whilst the caloric, being disengaged, passes off in the state of sensible heat.

Ignition is said to take place when this process goes on without the appearance of flame: *Inflammation*, when the combustible matter, assuming the gazeous form, burns in flame: and *Detonation*, when inflammation occurs with great rapidity and noise.

So high a degree of temperature may be produced by the access of oxygen, that by a stream of inflamed oxygen gaz, substances, otherwise refractory, may be easily fused. It is also decomposed by metals, the oxygen uniting with the metal, forming an *Oxyd*, the caloric escaping. This process is termed *Oxydation*.—From its being absolutely necessary to respiration, it has been termed *Vital Air*, it being absorbed, during respiration, by the blood in the lungs, which thereby acquires an augmentation of its vital powers, and becomes of a vermillion colour. It is plentifully emitted by vegetables during their exposure to light. But both this process, and that performed during the respiration of animals, will be more fully examined when the other constituents of air and of water have been treated of. It may be disengaged from its bases by the action of light, and by the application of such substances as have a superior degree of affinity with those bases, as will be shown when treating respectively of each.

Mr. Davy, who denies the existence of caloric, supposes Oxygen Gaz to be a substance compounded of light and oxygen. He terms it *Phos-Oxygen*.

Contributions, Physical and Medical, 1799.

HYDROGEN, as its name imports, contributes to the formation of water. It has only been obtained in combination.

HYDROGEN GAZ, sometimes termed Inflammable Gaz, is formed by the union of *Hydrogen* with *Caloric*.

It

It is about 12 times as light as common air, and has a disagreeable odour, which it loses when deprived of the water which it holds in solution, equal to half its weight. It is absorbed by vegetation, and is then supposed to become one of the constituents of oil. It is not fitted for respiration, though not immediately injurious. When by itself, it extinguishes flame; but being mixed with *oxygen* it burns with a brilliant flame, when any body already ignited is brought into contact with it. It is produced by the resolution of animal and vegetable substances, and by certain chemical processes, containing impurities according to the substances from which it is obtained.

WATER is formed by the union of *hydrogen* and *oxygen*. The proof of its composition is thus obtained:—Water being applied to the surface of heated iron, the quantity of water is diminished, the iron obtains an increase of weight, and an inflammable gaz is separated. The gaz thus formed, is found to be hydrogen gaz; and the increase of weight in the iron, which, with the weight of the gaz, equals the weight lost by the water, is found to proceed from the absorption of oxygen.—Again, if 14 parts of hydrogen gaz be burned with 86 of oxygen gaz, water is formed nearly of the same weight with the gazes employed. The composition of water, by the *ponderable part* of these gazes, is beautifully evinced by the experiments of Dr. G. Pearson, made with a view of ascertaining the nature of the gaz

produced by passing electric discharges through water.

Water, when pure, is transparent, colourless, and void both of taste and smell. It exists, according to the quantity of caloric with which it is combined, either in a solid state, when it is termed *Ice*, or in a state of fluidity, or of vapour.

It enters into the composition of most bodies in the animal, vegetable, and mineral kingdoms, either in a state of combination, or of simple mixture; contributing to the hardness and transparency of some bodies, as saline or stony crystals, and giving fixity to others, as the acids. On being converted to ice, it has its volume increased, and undergoes a confused crystalization; a sensible evolution of caloric taking place at the moment of congelation: passing again from the solid to the liquid state, caloric is absorbed, and coldness is produced.

NITROGEN, or *Azote*, the *Nitric Radical*, or *acidifiable basis* of nitric acid, has only been obtained in a state of combination.

NITROGEN GAZ, which has also been termed *Azotic Gaz*, or *Atmospheric Mephitis*, is formed by the combination of *Nitrogen* with *Caloric*. It forms more than two thirds of the air of the atmosphere, but alone, destroys animal life, and stops combustion. It may be obtained from the atmospheric air, when, by the oxydation of metals, by combustion, or by any other process, the other constituent of the air, the

the Oxygen Gaz, has been absorbed. It is lighter than common air, in the proportion of 985 to 1000, is not in the least acid, nor soluble in water.

ATMOSPHERIC AIR, that transparent, colourless fluid, which every where invests this Globe, possessing elasticity and gravity, is composed of *Nitrogen* and *Oxygen Gaz*, in the proportion of 73 of the former, and 27 of the latter, in a state of mixture, not of intimate combination. The constituent principles of atmospheric air are rendered evident by the following experiment.

Quicksilver being inclosed in a proper vessel of atmospheric air, on heat being applied, the air will be diminished, and the quicksilver lose its splendour, and gradually change to a reddish powder, acquiring, at the same time, an augmentation of weight. When neither the air nor the quicksilver suffers any farther change, the separation of the principles has taken place: the one, the gaz remaining in the receiver, is unfit for supporting flame, or maintaining respiration, and is nitrogen gaz; the other is absorbed by the quicksilver, whilst reducing to the state of an oxyde, and may be extricated from it on the application of heat, when the powder, to which the quicksilver is reduced, will be restored to its metallic state, but will have lost the weight it had gained during its oxydation; this deficiency being exactly equal to the weight of the evolved gaz, which is oxygen gaz.

These separated gazes, thus differing in their pro-

perties from each other, and from atmospheric air, being again mixed, form atmospheric air of the ordinary degree of purity. Atmospheric air containing in every 100 parts, 27 of oxygen, and 73 of nitrogen gaz.

It must, however, be acknowledged, that in thus forming respirable air, an aëriform fluid is obtained, differing in some trifling respects from the ordinary air of the atmosphere.

F. Von Humboldt supposes that our not being able to form an aëriform fluid, perfectly similar to that of the atmosphere, does not proceed from our ignorance of the quantity or quality of the gazeous bases, but from a difference in their union; that in the atmosphere they may be considered as in a state of chemical combination, but in the artificial, merely as a mixture. *Journal de Physique*, 1798.

Dr. Mitchill of New York supposes the matter of pestilence to be Septon (azote), chemically united with Oxygen, base with base, before they had attracted caloric enough to convert them to gazes, and give them the repellency incidental to that condition, as is the case when their two distinct gazes are merely mixed, as in atmospheric air.

The Doctor employs the term *Septon*, for Azote or Nitrogen.

Septous Gaz, for Azotic Gaz.

Septic Gaz, for Nitrous Gaz, &c.

Mr. Davy discovered that what he calls nitrous phos-oxyd, or gazeous oxyd of azote, is respirable when

when perfectly freed from nitrous phos-oxyd (nitrous gaz), and that it appears to support life longer than common air.—Dr. Mitchill's theory of contagion is of course, Mr. Davy says, completely overturned.

When mingled with 1-3d of Oxygen Gaz (Phos-Oxygen), animals live in it without any injury. Mr. D. made two inspirations of it, pure, without any disagreeable effects, and breathed it for some minutes with an equal quantity of Oxygen Gas, (Phos-oxygen) when the effects produced by it were very peculiar. *Nicholson's Journal, May* 1799.

Respiration and Combustion depending on the presence of Oxygen, these processes will always be affected by the proportion in which the Oxygen Gaz exists in the air in which they are performed. The atmosphere also contains foreign matters, such as other gazeous bodies, water which it holds in solution, minute detached particles of bodies, &c.

Nitre, with half its weight of sulphuric acid, being distilled, a yellow fuming liquor is first obtained, which is NITROUS ACID,* or *Glaubers fuming Spirit*

* The acids may exist in three states of combination with oxygen—1st, When their bases are not saturated with oxygen, which is designated, according to the present nomenclature, by the termination *ous*. 2dly, When completely saturated with oxygen, which is pointed out by the termination *ic*, and 3dly, When possessing an excess of oxygen, when the substance is said to be *oxygenated*.

Spirit of Nitre. The fumes which escape, appear to result from the fluid containing more Nitrogen, than the Oxygen it holds is capable of saturating; for if this acid be heated in a glass vessel until red vapours cease to be emitted, or if it be mixed with water, by which also red vapours will be made to issue copiously, the acid will, in both cases, have become true NITRIC ACID with its full portion of Oxygen; and the red vapours will be found to be NITROUS GAZ, which consists of Nitrogen with so small a portion of Oxygen, as not to impart to it any of the properties of acids.

Nitrous Gaz appears then, to consist of Nitrogen and Oxygen Gaz, in the proportion of $20\frac{1}{2}$ parts of the former, with $43\frac{1}{2}$ parts of the latter. It specific gravity is rather less than that of atmospheric air, it is unfit for respiration, does not maintain combustion, nor manifest any acid properties. It is in itself transparent and colourless, but assumes a red colour as soon as it meets with the oxygen of the atmospheric air.—A farther proof of the nature of its composition may be deduced from another process by which it is produced. The nitric acid being added to Iron, Copper, Zinc, &c. the metals are strongly oxydated and nitrous gaz is evolved: the metals here by absorbing the Oxygen of the nitric acid, having let loose the Nitrogen with a very small portion only of Oxygen.

Its composition is also proved by its decomposition, for pyrophori being burned in a vessel of nitrous gaz,

gaz, unmixed nitrogen gaz will be left, the other constituent, oxygen, having combined with the body in combustion.

From the avidity with which it absorbs oxygen to form nitric acid, it has been employed as an Eudiometer to measure the quantity of oxygen in the atmosphere; the diminution of volume in a given quantity of atmospheric air, to which the nitrous gaz is applied, giving the quantity of oxygen absorbed, and the quantity which the given quantity of atmospheric air contained.

NITROUS ACID GAZ is formed of the same constituent principles as the Nitrous Gaz, but in a different proportion, nearly 61½ parts of oxygen, being united with 20½ of nitrogen. It may be formed by the addition of Oxygen to Nitrous Gaz.

NITROUS ACID, or *Glaubers fuming Spirit of Nitre*, is formed when the nitrous acid gaz is condensed into a fluid. It is of a deep yellow colour, of a strong disagreeable smell, and emits red pungent vapours. It combines with almost all etherial fat or empyreumatic oils, forming with them a sub-resinous substance, which has somewhat of the odour of musk; sometimes inflammation is produced. With the empyreumatic oils of heavy woods, such as guaiacum, it forms a light porous mass, called Fungus Philosophicus.

NITRIC ACID, or AQUA FORTIS, is formed when a still larger proportion of Oxygen is united to Nitrogen, which we have seen may be accomplished

by

by abstracting the superabundant nitrogen from the foregoing acid. Nitric acid consists of 79½ parts of oxygen, and 20½ of nitrogen—when pure, it is nearly colourless. It gives a yellow colour to almost all animal substances, and dissolves and corrodes iron, copper, zinc, &c. with great rapidity, nitrous gaz being extricated. It unites eagerly with water, the mixture being first green, then blue, and lastly colourless. It thickens and blackens oils, converting them to a coal, or inflaming them, according to the nature of the oil, and the degree of concentration of the acid.

Professor Pictet having perceived a manifest smell of nitric acid, on the mixture of hot oxygen gaz with the atmospheric air, conceived that nitric acid was here formed by the chemical combination of the two constituent principles of that acid. But Mr. Nicholson, the Editor of the Journal of Natural Philosophy, suspects that the azote was furnished by the manganese, driven over after ignition took place.

From the facility with which nitric acid parts with its oxygen, it is employed as a proper vehicle in which the oxygen may be applied to certain acidifiable bases, to procure the peculiar acids of those radicals. For this purpose the nitric acid is added to the substance, containing the radical or base, and distilled from it, it passing over in the state of nitrous acid, nitrous gaz, or even nitrogen, according to the quantity of oxygen which has been subtracted from it by the acidifiable basis, now rendered

dered a peculiar acid. Thus are acids obtained from sugar, arsenic, &c. as will be hereafter shewn.

ALKALIS, whose general characteristics are, 1, an acrid, urinous taste; 2, changing the vegetable blues green; 3, combining with acids, and forming neutral salts; 4, facility of solution in water;—appear to be derived from *nitrogen*, which has therefore been esteemed the *alkaligene* principle, and are therefore considered in this place. They are divided into *volatile* and *fixed*.

AMMONIAC, or the *Volatile Alkali*. This has been proved to be a compound of *Nitrogen* and *Hydrogen*, in the proportion of about 6 of the former to 1 of the latter, with a certain portion of caloric. It seems to owe its origin to animal and vegetable decomposition. It is distinguished from the other alkalis by its pungent smell, and great degree of volatility. 1000 parts contain 807 of nitrogen, and 193 of hydrogen.

ALKALINE GAZ is formed by the combination of *Ammoniac* with *Caloric*. It is lighter than common air, is unfit for combustion, the flame enlarging before it is extinguished. It destroys animal and vegetable life: its other properties resemble those which have already been attributed to Ammoniac.

FIXED ALKALIS have for their peculiar characteristics, 1st, Their not being volatilized by the most intense heat. 2dly, The forming glass when fused with flinty substances. 3dly, The rendering oils miscible with water. Analogy, and even experiment, lead to the conclusion that they are formed

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by the combination of nitrogen, with some unknown basis, probably earth.

Pot Ash, or the *Vegetable Fixed Alkali*, is obtained by washing the ashes of burnt vegetables, or of the lees, or of the tartar of wine. When obtained from the two latter substances it has been called the *Salt of Tartar*, and when it has become fluid by imbibing moisture, it has improperly been termed *Oil of Tartar, per deliquium*. It is conjectured by Fourcroy, that pot-ash is the result of the combination of nitrogen with lime.

Soda, or the *Mineral Fixed Alkali*, is sometimes found in a native state, but is in general obtained by the combustion of maritime plants. It differs from pot-ash, in not being deliquescent, and in crystalizing in rhomboidal octohedrons; but the chief differences between them are observable in their respective combinations.

Like the former, this Alkali is supposed to be formed by a combination of Nitrogen with some other principle, which has also been supposed to be an earth: This earth has been supposed to be Magnesia by Fourcroy and Lorgna.

Professor Klaproth has discovered the *vegetable alkali*, in the fossil called *leucit*. Professor Abilgaart found that the *pot-ash* formed a constituent part of animal blood; and La Metherie and Gren, have discovered the *fossil alkali* in the Salsula Soda.

Nitrates are *Neutral Salts*, formed by the combination of nitric acid, with certain bases.*

Nitrate

* Neutral Salts are formed by the combination of the several

NITRATE OF POT-ASH, *Nitre*, or is *Saltpetre*, formed by the combination of the *Nitric Acid* with *Pot-ash*. It is produced spontaneously in various situations, sometimes efflorescing on the surface of the earth, and on the walls of old buildings; it is also found in some vegetables, in mineral waters, dunghills, &c. It may be artificially produced by the concurrent putrefaction of animal and vegetable substances. Light earths, such as lime and marle, magnesia and clay having little effect, ashes the refuse of soapmanufactories, &c. being stratified for this purpose with straw, dung, and putrifying animal and vegetable substances; wetted with urine, blood, dunghill water, and the mother waters of saltpetre; and turned and exposed to the current of air.

It is formed, in these processes, by the extrication of Nitrogen, which, combining with the Oxygen, forms the acid, this uniting with the alkali, which is separated at the same time, forms the Nitrate of Potash. It crystalizes in hollow hexahedral prisms, with pyramidal hexahedral extremities, yielding a pungent taste, and impressing the sensation of coldness on the tongue. It is soluble in 7 parts of cold and 1 of hot water. 100 grains contain 30 of Acid, 63 of Alkali, and 7 of Water. By distillation, it yields 12000 cubic inches of Oxygenous gaz for every pound

several acids with certain bases. The names by which these compounds are expressed terminate in *ate*, when their acids are completely saturated by oxygen, and in *ite*, when deprived of a certain quantity of oxygen.

of nitre, Caustic or pure Alkali being left behind.—Thrown on burning coals it yields a white flame. It fuses at a moderate heat, from the water of crystalization it contains. Fused until its water of crystalization isdisipated, and cast into moulds, or poured on to plates, it becomes what is called *Crystal Mineral*, or *Sal Prunel*. Mixed with an equal quantity of sulphur, and fused in a red hot crucible, the substance called *Sal Polycrest* is formed.

Being fused in a crucible, and powdered charcoal added till detonation ceases, Carbonate of Pot-ash is formed, which, purified, was formerly called *Fixed Nitre*, and in a state of solution in water, *Liquid Fixed Nitre*, or *Glauber's Universal Alkahest*.

The above process being performed in close vessels, a liquor distils, which is sometimes impregnated with nitrous acid and ammoniac, which has been called *Glyssus of Nitre*; Carbonate of Pot-ash remaining in the retort, the Oxygen combining with the inflammable body, by which an acid is formed, which uniting with the Pot-ash of the Nitrate, forms a new neutral Salt. 100 grains is found to contain 30 of acid, 63 of pot-ash, and 7 of water; and a mixture in this proportion, will, on evaporation, yield crystals of the purest Nitre, formerly called *Regenerated Nitre*.

Acidulous Nitrate of Potash, or *Nitrated Nitre*, is formed, if the nitric acid be employed beyond the point of saturation.

Nitrate of Soda, *Nitrated Soda, Cubic or Rhomboidal*

Rhomboidal Nitre, is produced by the artificial combination of *Nitric Acid* with *Soda*, not having been found in a native state.

It has a cool bitter taste, slightly attracts the humidity of the atmosphere, is soluble in 3 parts of cold water, and but little more soluble in hot water. It fuses on burning coals with a yellow flame; its other properties resemble those of Nitrate of Potash. 100 grains contain 28,80 of Acid, 50,09 of Alkali, and 21,11 of Water.

The strongest Nitrous Acid is to be found in Nitrated Soda. *Kirwan.*

NITRATE OF AMMONIAC, is formed either by the combination of the nitrous acid Gaz, with ammoniacal Gaz, or by the saturation of the Ammoniac with nitric Acid. It forms in beautiful flexile needle-like crystals, of a cooling but acrid taste. Exposed to the fire, it fuses, dries, and then detonates. 100 parts contain 46 of Acid, 40 of Ammoniac, and 14 of Water.

NITRATES with earthy bates.

NITRATE OF LIME, formerly termed *Nitrous Selenite*, is found adhering to, and embodied in, calcareous stones, and dissolved in various mineral springs. It is formed near inhabited places, and is yielded by the lixiviation of old plaster, and by the mother waters of saltpetre, as they are termed by the manufacturers. It forms acicular crystals of a sharp and bitterish taste, which readily deliquesce, and are very soluble in water. It fuses when exposed

to heat, parting with its acid in the form of Nitrogen and Oxygen Gazes; the earth which remains, after the fire has been considerably urged, is phosphorescent, and is called Baldwin's Phosphorus.

The Fixed Alkalis and Barytes precipitate the Lime. Sulphuric Acid unites with the Lime, and disengages the Nitric Acid. 100 parts contain 43 of Acid, 22 of Lime, 35 Water of Crystalization.

NITRATE OF BARYTES, has not yet been found native. It crystalizes difficultly, and though deliquescent, requires a considerable quantity of water for its solution. Neither Alkalis, nor the other earths, decompose it. But the Sulphuric Acid is detected in any mixture by this Salt, since by uniting with the Barytes, sulphates of Barytes, or ponderous Spar, is precipitated.

NITRATE OF MAGNESIA is found in decayed walls, &c. It forms tetrahedral columnar crystals, which taste acrid and bitter, are deliquescent and readily soluble, either in Water or Spirit of Wine. It is decompounded by Lime, Baryt, and fixed Alkalis, and by the sulphuric and fluoric Acids.

In 100 parts are 36 of Acid, 27 of Magnesia, and 37 of Water.

NITRATE OF ALUMINE, forms in small prisms, which are deliquescent, and give an astringent taste. In the fire they swell, and are decompounded, losing their Oxygen.

SULPHUR may be considered as a simple body, since

since it has not hitherto been decomposed. It is dry, brittle, of a yellow colour, and manifests electric attraction on being rubbed. It is found in and on the surface of the earth, both pure and in a state of mixture. It is said also to exist in certain vegetables, and to be formed during the putrefaction of animal and vegetable substances. It is separated from its impurities by sublimation, when it is termed *Sublimed Sulphur*, or formerly *Flowers of Sulphur*. By a moderate heat it may be fused; and in this state may be poured into moulds, to form it into rolls or sticks.

During its combustion it yields a blue flame, and a penetrating odour, Oxygen combining with the Sulphur in combustion, and forming the Acid to which it gives a name.

Sulphur combines with the fixed and volatile Alkalis, and with all the earths, except Alumine. The compounds being termed Sulphurets.

SULPHURET OF POT-ASH AND OF SODA, or *Alkaline Liver of Sulphur*, is obtained by melting two or three parts of the Alkali, with one of the Sulphur. This compound is a hard substance, of a brown liver-colour, which soon imbibes moisture from the atmosphere; when it emits an odour resembling putrid eggs, which proceeds from a gaz formed in consequence of the decomposition of the water; its Oxygen Gaz uniting with one part of the Sulphur, whilst its Hydrogen Gaz, dissolving also a portion, forms

Sulphurated Hydrogen Gaz, or *Hepatic Gaz*, thus formed, blackens most of the Metals and their Oxyds, destroys life, renders violets green, and burns with a light blue flame, depositing, at the same time, Sulphur. It also mixes with the Oxygen of the Atmosphere, forming Water and depositing Sulphur.

Sulphuret of Ammoniac, or, as it was formerly called, *Boyle's* or *Beguines fuming Spirit*, or *Volatile Liver of Sulphur*, is obtained in the form of a yellow fuming liquor, by the Ammoniac and Sulphur uniting, whilst in a state of Gaz, during distillation, from one part of Sulphur, two of Ammoniac, and six of Quick-lime. Like the other Sulphurets it is decomposed by acids: and if the concentrated sulphuric acid is employed, a dangerous degree of heat, and explosive effervescence will be produced.

Sulphuret of Lime, formerly called *Hepar of Lime*, is formed either in the dry or moist way, by the mixture of one part of Sulphur and two of Quick-lime. When recent and dry, it absorbs light, and shines in the dark; when the Lime of Oyster-shells is employed, it is termed, from its inventor, *Canton's Phosphorus*.

It speedily loses its taste and smell, by exposure to the atmosphere; and suffers decomposition by acids, like the other Sulphurets, sulphurated Hydrogen Gaz being disengaged.

Sulphuretes of Baryt. This combination also

also absorbs light, and shines in the dark; this is the *Bononian Phosphorus*. Ponderous spar, made into little balls, with mucilage of tragacanth, are heated with charcoal in a crucible, for this purpose, and is thereby rendered a Sulphuret of Barytes.

SULPHURET OF MAGNESIA, or *Hepar of Magnesia*, is formed by the digestion of equal parts of Sulphur and Magnesia in Water. The Magnesia is precipitable by Fixed Alkali, which has a stronger affinity with the sulphur. It affords small crystalline needles by spontaneous evaporation.

Sulphurets combined with Nitre, also called *fulminating powder*, in the proportion of one part of the former to two of the latter, or one part of Sulphur, two of dry carbonate of Pot-ash, and three of Nitre, being placed in a small quantity on a shovel, and gradually heated until it melts; the mass swells, a slight flame is perceived, and, in that instant it explodes with much violence, by the inflammation of an extremely inflammable fulminating gaz, formed by the hepatic gaz from the Sulpheret and the Oxygen from the Nitre. In the combustion or detonation of Gunpowder, which is a mixture of Sulphur, Nitre, and Charcoal; at the instant of explosion the Sulphur and Carbon receive Oxygen from the Nitre, and become Sulphureous and Carbonic Acid Gazes; Nitrogen Gaz is also produced from the Nitre, and the Water is changed to Vapour.

SULPHURIC ACID, formerly called *Spirit* or *Oil of Vitriol*, is formed by the combination of Sulphur, which

which is its basis, and Oxygen. It is obtained, when combustion of the Sulphur is carried on very slowly, the air being allowed a long time to digest with the Sulphur; but it is produced with more facility by the addition of Nitre, which furnishes Oxygen abundantly. It is also obtained by distillation from Sulphur and Nitric Acid, in the proportion of 48 ounces of the Acid to two ounces of the Sulphur. 100 parts contain from 69 to 72 of Sulphur, and from 28 to 31 of Oxygen.

It suffers congelation by intense cold, is unctuous to the touch, attracts moisture from the atmosphere with great avidity, and when mixed with water produces heat beyond that of boiling water. It acts rapidly on all inflammable substances, rendering them black, the acid itself becoming brown or even blackish.

The Sulphureous Acid is formed by this addition of inflammable matter, in consequence of a decomposition of the Acid, the inflammable body having deprived it of a considerable portion of its Oxygen. This change is effected by digesting almost any animal or vegetable substance, or even Sulphur in the Sulphuric Acid, but it gradually absorbs Oxygen from the atmosphere, and returns to the state of Sulphuric Acid.

The Sulphureous Acid Gaz may be obtained in all those processes in which any inflammable body deprives the Sulphuric Acid of a part of its Oxygen. It is a compound of Sulphur and Oxygen

gen, the latter being in a less proportion than in the Sulphuric Acid, with a certain quantity of Caloric. This Gaz has an acid taste, and the acrid and penetrating smell of Sulphur. It destroys animals, and extinguishes ignited combustible substances. It unites rapidly with ice, which melts by the heat disengaged during its fixatien.

SULPHATES are neutral Salts, formed by the Sulphuric Acid with certain bases.

SULPHATE OF POT-ASH, formerly called *Arcanum Duplicatum, Sal de duobus, Vitriolated Tartar, & Vitriol of Potash*, is produced by the combination of the Sulphuric Acid and Pot-ash. It forms in crystals of hexahedral prisms, terminating in hexahedral pyramids, with triangular faces, having rather a penetrating bitter taste, and are soluble in 16 parts of cold water. 100 grains containing 30,21 of Acid; 64,61 of Alkali, and 5,18 of Water.

It decrepitates on hot coals; but with greater heat it fuses, and is volatilized without decomposition. It may be supersaturated with its acid, when it forms the *Acidulous Sulphate of Pot-ash*. This Salt efflorseces in the air.

The strongest Sulphuric Acid, Mr. Kirwan remarks, exists in this Salt.

SULPHATE OF SODA, formerly called *Glaubers Salt, Sal Mirabile, Vitriol of Soda, &c.* is formed by the combination of Soda, with the Sulphuric Acid. It is found in various mineral waters, and

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is yielded very plentifully by the *Tamarix Gallica*, on the sea coasts, in the South of France.

It has a very bitter taste, crystalizes in triangular octohedrons of a prismatic figure, swells and boils upon heated coals, effloresces in the air, and is soluble in its own weight of boiling water, and in 3 parts of cold. 100 parts contain 14 of Acid, 22 of Alkali, 64 of Water. It is decomposed by Pot-ash and Barytes.

ACIDULOUS SULPHATE OF SODA, is formed when it is supersaturated by its own Acid.

SULPHATE OF AMMONIAC, called formerly *Glaubers Secret Ammoniacal Salt*, is formed by the direct or indirect combination of its con stituent parts. It is said to be found near Volcanos in Tuscany. Its crystals are thin hexahedral prisms, with pyramidal extremeties, are very bitter, melt with heat, and losing their water of crystalization, they fuse, and are partly volatilized.

Mr. Hatchet observes, that the whole of it may be raised and a great part decomposed, merely by the employment of a proper degree of heat. He also supposes that most, if not all of the ammoniacal salts suffer different degrees of decomposition, whenever they are treated in the dry way.

Phil. Trans. 1795.

It is dissolved in its own weight of boiling water, and twice its weight of cold water.

It parts with the Ammoniac on the addition of fixed Alkali, Barytes, and Lime.

SULPHATES

SULPHATES with *earthy bases*.

SULPHATE OF LIME, or *Selenite* or *Gypsum*, is formed of *Lime* and *Sulphuric Acid*. Exposed to fire, it is reduced to a white powder, called *burned Gypsum*. Water is speedily absorbed by this powder, rendering it a paste, which soon hardens. If violently urged by heat, it forms a light coloured glass. It may be decomposed by the fixed Alkalis and Baryt, which unite with the Sulphuric Acid, and leave the Lime disengaged. It requires 500 parts of cold water to hold it in solution. 100 parts contain 32 of Lime, 30 of Sulphuric Acid, and 38 of Water.

SULPHATE OF BARYT, or *Ponderous Spar*, is formed by the *Sulphuric Acid* and *pure Barytes*. It is generally found in rhomboidal plates. It is less soluble than Sulphate of Lime; when heated, becomes luminous, and by violent heat, vitrifies. Neither Alkalis nor the other Acids have any action on this Sulphate. 100 parts contain 30 of Acid, 67 of Baryt, and 3 of Water.

SULPHATE OF MAGNESIA, also called *Epsom Salts*, or *Sal Amarus*, is formed by *Magnesia* and *Sulphuric Acid*. It is found in various mineral waters, and even in a solid form in the fissures of rocks. Its crystals are four sided columns, with four sided extremities, but in general are acicular, and of a very bitter taste. 1000 parts of cold water dissolve about 800 of this Sulphate, but 1000 parts are dissolved in only 666 of boiling water. It is

decomposed

decomposed by Lime and Barytes, which unite with the Acid, and deposit the Magnesia. Magnesia is obtained generally by decomposing this Sulphate, by the addition of fixed Alkali to its solution; the Magnesia being afterwards cleared from its impurities by repeated ablutions, and if required to be perfectly pure, by exposure to a considerable degree of heat. By the addition of a small quantity of Sal Soda to the vegetable Alkali, the Magnesia is obtained beautifully light. 100 parts of this Sulphate contain 24 of Acid, 19 of Magnesia, and 57 of Water.

Sulphate of Alumine, or *Alum*, is formed by the *Sulphuric Acid* and *Alumine*. It is found in marshy black soil, or in sand at the bottom of some lakes; in a crustaceous form, in the neighbourhood of lavas, or in tender capillary silver-white crystals, inclining to green, of a sweetish astringent taste, called *Capillary Allum*. *Haarsalze*, *Halotrichium*, or *Trichites*, or in soft brittle masses, feeling somewhat greasy, of a dark yellowish colour, called by the Germans, *Stone-butter*. Its crystals are two tetrahedral pyramids, base to base, which dissolve in 17 times their weight of cold water, and in rather less than their own weight of boiling water. In a moderate heat it swells, loses its water of crystalization, and becomes a light white substance called *burnt-alum*. In a more violent degree of heat, it loses part of its acid, and becomes tasteless, is no longer susceptible of crystalization, but precipitates

cipitates from its solution, in a very fine adhesive powder. Magnesia, Barytes, and the Alkalis, precipitate it from this solution; but the alkalis added in excess, re-dissolve it. 100 parts contain 19, 78 of standard Acid, 18 of Earth dried in a high red heat, and 44 of Water of crystalization, the remainder, water of composition.

SULPHITES are neutral Salts, formed by the union of *sulphureous Acid* with certain bases. Fourcroy and Vaucquelin, examining the properties of sulphureous Acid and its combinations, observe that the sulphites differ very much from the sulphates, and that they possess, 1. a sulphureous taste, similar to that of the acid. 2. They are decomposable by fire, either by the escape of their acid, without alteration; or by losing a portion of sulphur, and becoming converted into sulphates. 3. They are converted into Sulphur by the contact of air, or of any substance capable of affording Oxygen, and their weight is increased by this conversion. 4. They are decomposed by most acids, which expel the sulphureous acid with effervesence, and the production of a strong penetrating odour. 5. They burn rapidly and with flame, when heated with super-oxygenated muriate of Pot-ash, or with Saltpetre, and become sulphates. 7. Lastly, the sulphite of Lime is not decomposed by the Alkalis, like the sulphate.

CARBON, *Charcoal*, is a simple body; black, sonorous, and brittle, and is obtained from various sub-

 stances

stances in the animal, vegetable, and mineral kingdoms, generally by volatilizing their other constituent parts. When obtained in a state of purity, it resists the strongest heat in closed vessels. It decomposes sulphuric Acid, from its affinity with Oxygen exceeding that of Sulphur. It decomposes nitric Acid with great rapidity, and if the charcoal be first powdered, and the acid strong, and allowed to run down the sides of the vessel, to mix with the Charcoal, it burns with rapidity, with a beautiful flame, throwing up the powder, so as to resemble a beautiful fire-work. With Nitrate of Pot-ash, it detonates in a hot crucible, leaving a fixed Alkali behind. It is dissolved by the Alkalis, and by the sulphurets of Alkali, both in the dry and mixt way. It does not unite with metals, but restores their oxyds to a metallic state. If burnt in contact with air, its acidifiable base attracts Oxygen, and becomes a peculiar Acid, which, with a certain portion of Caloric, assumes a gazeous form.

Carbonic Acid Gaz, formerly termed *fixed Air*, or *aërial Acid*, is formed by the combination just mentioned, of Carbon, Oxygen, and Caloric. Its composition appears to be 28 parts of Carbon, and 72 of Oxygen, with a certain portion of Caloric. Pure Carbon being burnt in a vessel of Oxygen Gaz, carbonic Acid is directly formed, in a quantity precisely equal to that of the Carbon and Oxygen employed. It is heavier than the Air of the atmosphere, in the proportion of $1\frac{1}{2}$ to 1; has a penetrating

ting odour and sour taste, and will serve neither for respiration nor combustion. It is found in a gazeous and pure state, in many subterraneous places. It is generated during the decomposition of animal and vegetable substances, particularly during the fermentative process, and is found in the air of the atmosphere in a very small proportion. It readily combines with cold water, to which it gives a peculiar pungent taste, rendering it manifestly acid, heat or congelation again separating it from the water. It exists in a concrete state, in combination with alkalis and earths, particularly in the calcareous, causing these substances to exist in a mild state, which always, when perfectly pure, manifest a considerable degree of causticity. It also renders them effervescent with Acids, from its liberation in a gazeous state, in consequence of the new combination. The superior degree of attraction of Carbon for Oxygen, renders it very difficult of decomposition.

Mr. Smithson Tennant, however, by exposing carbonic acid Gaz to phosphorus, and calcareous earth in a red heat, obtained, as he supposed, a decomposition of the carbonic acid Gaz. The Oxygen united with the Phosphorus, and composed the phosphoric acid, which united with the calcareous earth, the Carbon being deposited pure, differing in no respect from the charcoal yielded by vegetable matter. *Phil. Trans*, 1791.

Dr. Pearson, who does not think that the Charcoal and phosphoric Acid, are the necessary result of

the agency of the affinities, as stated by Mr. Tennant observes, that some chemists have conjectured that the Charcoal, in Mr. Tennant's experiment, either pre-existed in the phosphorus, which is distilled from Charcoal, or had arisen from accidental impurities. Dr. Pearson, however, made several experiments by which the carbonic Acid was decompounded, and resolved into respirable Air and Charcoal. *Phil. Trans.* 1793.

Professor Göttling informs us that, by heating over a charcoal fire, in a glass vessel, a mixture of Phosphorus and Carbonate of Soda, or Carbonate of Pot-ash, the Phosphorus will be kindled, and its greatest part consumed, and that the residuum is of an uniform black colour, the salts of which being dissolved in water, there remains an insoluble Carbon, of a deep black colour. *Göttling's Almanach.*

From experiments made on carbonated hydrogenous Gaz, or, as it has been also termed, heavy inflammable air, which has been proved to be a solution of Charcoal in light inflammable air; Dr. Austin concluded Charcoal to be a compounded body, of which one of its constituents is Hydrogen, and the other Azote.

Phil. Trans. 1790.

Dr. Beddoes employed this theory in explaining some of the appearances that attend the conversion of cast into malleable Iron.

Phil. Trans. 1791.

But Mr. W. Henry has detected several fallacious inferences made by Dr. Austin, from his experiments,

riments, and concludes, that Carbon is still to be considered as an elementary body, that is, as a body with the composition of which we are hitherto unacquainted. *Phil. Trans.* 1797

CARBONATES are neutral Salts, composed of the *Carbonic Acid*, and certain *bases*.

CARBONATES with *alkaline bases*.

CARBONATE OF POT-ASH, formerly called *aërated Pot-ash*, or *aërated vegetable Alkali*, is made by exposing a solution of Alkali to the carbonic acid Gaz, until saturated, when it will yield tetrahedral crystals, terminating in similar short points. It has now less of the urinous taste, but still changes the infusion of violets green. It does not attract moisture from the air, but rather parts with its water of crystalization. By exposure to heat, it loses its Acid, is rendered pure Alkali, and capable of uniting with Silex and forming Glass; it is decomposed by Quicklime, and by all the Acids. Four parts of cold Water are required for its solution. 100 parts contains 20 of Acid, 48 of Alkali, and 32 of Water.

CARBONATE OF SODA, formerly termed *aërated mineral Alkali*, when completely saturated with carbonic Acid, yields rhomboidal crystals of a squamous appearance. It is decomposed by Quick Lime, by the Acids, and by Fire, in the same manner as the former Carbonate. It soon parts with its water of crystalization; contains in 100 parts, 16 of Acid, 20 of Alkali, and 64 of Water; and in a saturated

solution, takes two parts of cold, but only equal of hot Water.

Carbonate of Ammoniac, or *concrete volatile Alkali*, may be obtained from many animal substances, but it is not found naturally in this state. It is formed by the combination of carbonic Acid with pure Ammoniac. This may be effected by passing the carbonic acid Gaz through a solution of Ammoniac; by exposing the Ammoniac in a vessel of the carbonic acid Gaz; or by distilling it from a mixture of Ammoniac and the carbonate of Potash, or Carbonate of Lime, or other neutral Salts containing this Acid. It dissolves in its own weight of cold Water, and contains in 100 parts, 45 of Acid, 43 of Alkali, and 12 of Water. It may be decomposed by most of the Acids, their affinity with Ammoniac exceeding that of the Carbonic.

Carbonate of Lime, also called, *mild calcareous Earth*, *Chalk*, &c. is formed by the combination of *carbonic Acid* and *Lime*. Its varieties will be noticed, when the various combinations of Earth, &c. forming Stone, are particularly treated of. It has not been crystalized by art, although found variously crystalized in its native state. By intense heat, the Acid is disengaged, and *pure Lime* remains. It is decomposed by almost all the Acids, by their superior degree of attraction for Lime, forming other calcareous Salts; the carbonic Acid, escaping in a gazeous form, and occasioning effervescence. *Acidulous Carbonate of Lime*, is formed by

by the solution of this Carbonate in Water, impregnated with carbonic Acid.

CARBONATE OF BARYT. This combination has no taste, is not altered in the Air, is almost insoluble in Water, but is decompounded, by heat, and by all the Acids. 100 parts contain 65 of pure Baryt, 28 of Acid, and 7 of Water. Dissolved in Water impregnated with carbonic Acid, it is the most effectual test of the presence of sulphuric Acid. *Guyton.*

CARBONATE OF MAGNESIA, or the Magnesia of the Shops, is not found in this combination, but is obtained by precipitation with the Carbonates of Alkali from the Sulphate of Magnesia. It is soluble in Water, in the proportion of several grains to an ounce. It loses its Water and Acid by calcination, the residue being *pure Magnesia*, sometimes called *calcined Magnesia*. 100 parts contain 30 parts of Acid, 48 of Earth, 22 of Water. Cold water dissolves more than hot, it is therefore precipitated by heating the solution. *Butini.*

CARBONATE OF ALUMINE is formed by the Acid of the carbonates of Alkalis, combining with the Earth thereby precipitated from a solution of Alum.

MURIATIC ACID, formerly termed *Marine Acid*, or *Sea Salt*, &c. is conjectured, from analogy, to consist of *Oxygen*, in combination with a peculiar, but hitherto *unknown basis*. It is obtained by distillation, from a mixture of Sea Salt, with

half

half its weight of sulphuric Acid, and from its combination with water, we have it in a fluid form. When pure, it is colourless, and of a less specific gravity than the nitric Acid. It has a peculiar suffocating smell, and copiously emits vapours, which are rendered more visible by their mixture with the moisture of the Atmosphere. It absorbs the carbonic Acid, and its affinities with Baryt, Pot-ash, Soda, Ammoniac, Lime, Magnesia, and Alumine, appear to be in the order they are here placed.

Muriatic Acid Gaz, is obtained by receiving the muriatic Acid Vapours on Quick-silver; it thus preserving a gazeous form at the temperature of the atmosphere. It is heavier than common Air, extinguishes flame, first enlarging it, by a greenish or bluish circum-ambient flame. It suffocates animals, and is so caustic as highly to inflame the skin. It unites with Water with great rapidity and heat, forming the Fluid Muriatic Acid.

Oxygenated Muriatic Acid, is formed by the addition of *Oxygen* to the *muriatic Acid*, which it seizes with avidity, whenever it is presented to it. It is therefore readily obtained by distillation of the muriatic Acid, from substances containing much Oxygen; such are the oxyds of metals, particularly the native oxyd of Manganese. The Acid is, in this state, of a yellowish colour, of an austere but not an acid taste, and of an excessive strong disagreeable smell; its vapours irritating the larynx violently. It renders the blue colours of vegetables white, and thus destroys

destroys the colour of most substances, thereby losing its Oxygen. When below the freezing point, it crystalizes, in quadrangular prisms. It oxydates metals with rapidity, and thickens oils. By communicating its Oxygen to Sulphur, it produces the sulphuric Acid, and in the same manner converts nitrous Gaz into nitric Acid, it becoming ordinary muriatic Acid. Exposed to the light, Oxygen Gaz is separated, and ordinary muriatic Acid is left; and as its loss of Oxygen is in a direct *ratio* of the quantity of light, this oxy-muriatic Acid has been proposed as a *photometer*.

It seems to differ from the common muriatic Acid, on the same principle as the nitric and sulphuric Acids differ from the nitrous and sulphureous; the simple oxygenated muriatic Acid appearing to be formed, according to the greater or less quantity of Oxygen, united to the pure radical.

When it is mixed with Ammoniac, decomposition, with great effervescence, takes place: no neutral Salt is formed; but the Hydrogen of the Ammoniac, combining with the superabundant Oxygen of the Acid, forms Water, the Nitrogen escapes in the state of Gaz, and common muriatic Acid is left. If the Acid and the Ammoniac are mixed in the state of Gaz, considerable detonation and inflammation succeed.

Phosphorus and Carbon immediately unite with its Oxygen, and form phosphoric and carbonic Acids.

It

It removes the stain of common ink, though it does not affect printer's ink. It is therefore recommended for cleaning old books and prints. Half an ounce of minium being added to three ounces of common muriatic acid, will render it fit for this purpose.—*Fabroni Giornale Litt. di Napoli.*

It powerfully bleaches linen, cotton cloths, and paper; and in the proportion of twelve ounces to forty eight pounds of spirit of wine, it is exceedingly efficacious in bleaching raw silk, and even entire garments. *Journal de Physique.* XLIII.

MURIATES, are neutral Salts, formed by the *Muriatic Acid*, and certain *Bases*.

MURIATE OF POT-ASH, the *febrifuge Salt of Sylvius*, is formed by the combination of *muriatic Acid* with *Pot-ash*. In 100 grains, are contained, 29,68 of Acid, 63,47 of Alkali, and 6,85 of Water. It is found in sea-water, in old plaster, and in the ashes of tobacco. It crystalizes in cubes, or in tetrahedral prisms, which have a strong, bitter, disagreeable taste.

MURIATE OF SODA, *Marine Salt*, *Common Salt*, *Rock Salt*, or *Sal Gem*, is rendered impure by the mixture of sulphate of Lime; Bay Salt by the muriate of Magnesia; and River Salt by both. It is formed by the combination of *muriatic Acid* with *Soda*. In 100 grains are contained 33,3 of Acid, 58 of Alkali, and 16,7 of Water. It is found native in mines in many places, but particularly in Poland and

and Hungary. These mines appearing, from the shells, madrepores, &c. which are found in them, to have been formed by the drying up of vast Lakes. It is also obtained by extracting it from Sea Water, by evaporation, &c. Its purification is accomplished by adding a solution of pure Soda, until no precipitation takes place. The Soda decomposes both the muriate of Magnesia, and muriate of Lime, contained in the liquor, by attracting their Acid, the Magnesia and Lime which it quits falling to the bottom. The sulphate of Soda thus formed, is separated when they liquor cools, which should be allowed as soon as crystals of sulphate of Soda will form, the muriate of Soda being obtained by a farther evaporation. It is not decompounded by silex, and but slightly by clay. It however occasions clay to fuse readily, and is employed in glazing earthen ware. It assists the fusion of glass also. It has a penetrating pleasant taste, decrepitates on hot coals, and by great heat, is volatilized without decomposition. It crystalizes in cubes, the addition of fresh urine producing crystals of an octohedral form, soluble in 2,5 times their weight of cold water. It yields Soda in considerable quantities by the following processes. 1. By adding nitric Acid, which, uniting with the Soda, forms the nitrate of Soda, from which the Soda is obtained by detonation. 2. By adding Pot ash, which, uniting with the muriatic acid, displaces the Soda. 3. By mixing the Oxyds of Lead. 4. By treating it with Barytes. 5. By mixing

mixing it with vegetable acid combined with Lead, the muriatic acid uniting with the Lead, and forming a muriate, whilst the Soda combines with the vegetable Acid, from which it may be afterwards freed by evaporation and calcination.

MURIATE OF AMMONIAC, or *Sal Ammoniac*, is formed by the combination of the muriatic acid with Ammoniac, and is found native in many parts, particularly in the neighbourhood of Volcanos. It is obtained artificially, by distillation from the soot, formed by the combustion of the excrements of Animals which feed on saline Plants. 100 parts contain 52 of Acid, 40 of Ammoniac, and 8 of Water. It crystallizes in quadrangular prisms, terminating in quadrangular pyramids; or in rhombic crystals, of a sharp, acid, urinous taste, showing a slight degree of ductility under the hammer. It dissolves in three parts and a half of water, at 60° of Fahrenheit. It is not decomposed by Clay, nor entirely by Magnesia: but is completely decomposed by Lime, and fixed Alkalis. The Ammoniac being disengaged in the state of Gaz, leaving a muriate of Lime or of Alkali. If the Lime or fixed Alkali is pure, Caustic or pure Ammoniac is obtained, but if the Carbonate of Lime or of Alkali be employed, then a Carbonate of Ammoniac is the result of the process.

MURIATES with *Earthy Bases.*

MURIATE OF LIME, *Muriated Calx*, *Calcareous Marine Salt*, or *Glaubers fixed Sal Ammoniac* Is found in Mineral Waters, but particularly in the

the waters of the Sea, to which it contributes to give their bitter taste. It speedily deliquesces, and therefore, crystalizes with difficulty, in tetrahedral prisms, with four-sided pyramids. 100 parts of Lime, take up 86 of real marine Acid. It is decomposed by Barytes, and the Alkalis. It fuses with a moderate heat, and by calcination, becomes the *Phosphorus of Homberg*. A very strong solution, being mixed with the concentrated sulphuric Acid, a solid precipitate is formed, and the Acid disengaged in vapours; the two liquids appearing to be instantly transformed into a solid. Mr. Kirwan first suggested that the sulphurets might be carefully employed, from their detergent properties, in bleaching. Mr. W. Higgins has since succeeded with them, by employing alternate immersions in a solution of the sulphuret of Lime, and of this Salt-oxygenated.

MURIATE OF MAGNESIA exists in the mother water of Salt-works, in springs, and in the waters of the Sea. It forms acicular, but deliquescent crystals, of an acrid and bitter taste. 100 parts contain, 34 of Acid,—41 of Magnesia,—25 of Water.

MURIATE OF BARYTES does not seem to exist native. When obtained artificially, it crystalizes in cubes, which do not suffer any change in the air, nor in the fire, and have a nauseous and burning taste. Pure Alkalis and Earths have no effect on this Salt. The sulphuric and fluoric Acids

 decompose

decompose it very readily; hence this salt is highly useful to detect the presence of these Acids in any mixture.

MURIATE OF ALUMINE crystalizes with difficulty, leaving generally, after evaporation, a saline astringent mass, of a gummy consistence.

OXYGENATED MURIATE OF POT-ASH is formed by introducing the oxygenated muriatic Gaz into a solution of Pot-ash; its crystals, as well as those of the common muriate being formed on evaporation in the dark. The oxygenated muriate gives a faint taste, with a sensation of coldness in the mouth; the crystals have somewhat of a silvery appearance, and emit light by attrition.

It appears to contain more Oxygen, than an equal weight of oxygenated muriatic Acid in Water: hence the Acid, combined in the muriate, is supposed to be super-oxygenated.

It is decomposed by the action of light, parting with its oxygen, and becoming simple muriate.

This is, however, denied by Mr. Hoyle.

Manchester Memoirs, Vol. V.

Heat also separates its Oxygen from it, in the form of oxygenous Gaz, 100 grains yielding 75 cubic inches of oxygen gaz.

On being brought into contact with inflamed bodies, it detonates with more violence than Nitre, producing very loud reports, probably by the sudden stroke on the air, by the rapid production of Gaz. When mixed with equal quantities of sublimed

limed Sulphur, it explodes, by more trituration, and spontaneously, if kept in a bottle.

Nicholson's Journal.

A grain or two of Phosphorus being dropped in a solution of the oxygenated muriate in nitric acid, a great number of vivid flashes appear in the liquor.

A little of this muriate being put into the sulphuric acid, violent cracklings or small explosions succeed, and if a small piece of Phosphorus be also dropped in, a violent explosion takes place: the addition of heat will also occasion its explosion. This muriate being rubbed with an equal quantity of Phosphorus, a violent explosion follows with a flash of light. If mixed with Charcoal, and smartly struck with a hammer, flame, but not much noise, succeeds; but with pit-coal, sparks, and some small reports are produced: with Sulphur a report and flame; and with sulphuret of Pot-ash, and of Arsenic the same effects follow, but in a higher degree. Detonations in various degrees are occasioned by its being rubbed with loaf sugar, oils, camphor, rosin, gum-arabic, indigo, aurum musivum, &c.

Manchester Memoirs, Vol V. Part I.

The oxy-muriate of carbonated Pot-ash increases the blackness of ink, used in the proportion of 1 to 5 of the sulphates contained in the ink. The colours of logwood, weld, cochinelle and archil, are improved by it, if no heat be employed. Being blended with soap, the soap is improved in its qualities.

A. J. Forsyth, Nicholson's Journal, July 1799.

Being employed in the fabrication of gun-powder instead of Nitre, the effects produced by its ignition, are augmented to a four-fold degree; and the mixture will explode by mere trituration.

Oxygenated Muriate of Soda differs from that of Pot-ash, in being more disposed to effervescence, and to solution in alcohol.

Nitro-Muriatic Acid, or *Aqua Regia*, is formed by the combination of the *Nitric* and *Muriatic* Acids. It may be obtained, by distillation, from four ounces of nitric Acid, and two of common Salt; or from two parts of muriatic Acid, and one of nitrate of Pot-ash. It is also obtained by the distillation of nitre of the first boiling. Four ounces of Sal-ammoniac dissolved gradually, in the cold, in one pound of Nitric Acid, forms an Aqua Regia. It is also formed by two parts of pure Nitric Acid, and one of Muriatic. The muriatic in all these processes, attaching to itself a portion of the oxygen from the nitric Acid, as well as a portion of nitrous Gaz. It is of a yellow colour, and its specific gravity is less than that of either of the Acids employed. It readily dissolves Gold, which is not done by either of the acids of which it is composed. It is employed by the dyers for the solution of Tin, which nitric Acid corrodes, and oxydates without dissolving.

Acid of Borax, formerly called *Homberg's Sedative*

Sedative Salt, has been found naturally formed in several parts, but it is generally found in combination with Soda, forming Borax, from which it is obtained by sublimation, or crystalization. It is obtained by sublimation, by dissolving three pounds of calcined sulphate of Iron, and two ounces of Borax, in three pounds of Water; filtering it, and evaporating to a pellicle; the mixture then yielding the Acid by sublimation. The nitric and muriatic Acids may be employed for the same purpose; but half its weight of sulphuric Acid poured on Borax, yields the Acid by sublimation, in a beautiful state. It is also obtained by crystalization, by adding sulphuric Acid, to a solution of Borax in hot water. The salt is deposited on the sides of the vessel, as the mixture cools: it is also separated by the vegetable Acids. It yields a saline cool taste, and reddens the blue vegetable infusions. It requires one pound of boiling water for the dissolution of 183 grains, but is dissolved more easily in Alcohol; the solution being of a beautiful green, and burning with a green flame. Exposed to the fire, it becomes a vitriform and transparent substance, if dry; but if moist, it sublimes.

BORATE OF SODA, or *Borax*, is formed by the combination of *Acid of Borax* and *Soda*. It is found in a crystalized state, at the bottom of certain salt Lakes, in a barren, volcanic district of the kingdom of Thibet. This kind, which is invested in a greasy covering, is called *Brute Borax*, *Tincall*, or

Chrysocollæ. It is also found in a purer state in the mines of Riquintipa, and of Escapa. A still purer kind comes from China. It is purified, by adding to it solution of Soda, and by re-crystalization; but, by this process a great proportion of Alkali is retained by the Salt. Calcination also destroys the oily part, but this process is attended with a considerable waste. It is best obtained in a pure state by long boiling; the crystals this affords, being again purified by a second filtration and crystalization. When purified, it is white and transparent, with somewhat of a greasy fracture. It has a pleasant acid taste, renders the blue vegetable infusons green, and forms in crystals which are hexahedral prisms, terminating in similar pyramids. It requires 18 times its weight of water at 60° Fahrenheit, to dissolve it, but is dissolved in one sixth of its weight of boiling water. Exposed to a moderate heat, it melts with its water of crystalization, and is reduced into a white opake light mass, when it is commonly called *Calcined Borax.* In a more violent heat it is fused into a transparent greenish yellow glafs, soluble in water, and effloresceing in the air. Barytes, Magnesia, and Lime, decompose Borax. It serves as a flux to vitrifiable earths, it also vitrifies clay, but less completely. It is employed in forming reducing fluxes; it may also be used in re-producing the fusion of glass; and in soldering metals it is highly useful, cleansing the surface

face of the metal, and assisting the fusion of the solder.

BORATE OF POT-ASH, formed by the combination of the *Acid of Borax*, with *Pot-ash*, is obtained either by adding Pot-ash to a solution of Borate of Soda, or by directly combining the Acid with the Pot-ash.

FLUORIC ACID is derived from the Spar, formed by this *Acid*, and *Calcareous Earth*, and from its property of accelerating the fusion of other Stones, is termed FLUOR SPAR. It is thus obtained. The Stone is distilled in a leaden retort, with its own weight of sulphuric Acid, when a gaz termed Fluoric Acid Gaz, is detached, which forms the Fluoric Acid, on coming in contact with water; the sulphuric Acid, at the same time, forming Gypsum, by combining with the calcareous earth. Being distilled in glass, it seizes the siliceous earth of the glass, and volatilizing it with itself, deposits it as a siliceous crust on the surface of the water in the receiver. On being mixed with Pot-ash, a gelatinous substance is formed, which retains one fifth of the Alkali; with Soda, the effects are nearly similar: with Ammoniac, it forms a jelly, which, when dry, resembles Silex; and on being added to Lime-water, the spar is regenerated. It does not act on Gold, or Silver, but

but combines in preference with their Oxydes. It is employed for the purpose of etching on glass.

FLUATE OF POT-ASH readily dissolves in water, deliquesces in the atmosphere, and is with difficulty crystalized. It is decompounded by Lime, the Lime uniting with the Acid, and forming regenerated Fluor: it is decomposable also by the sulphuric Acid.

FLUATE OF SODA is not readily soluble in water. It forms small oblong tetrahedral crystals, which decrepitate like common Salt, and are decomposable in the same manner, as the former.

FLUATE OF AMMONIAC shoots into small columnar crystals, which have a bitter taste, and are deliquescent. It is perfectly sublimable by heat, and acts upon glass, and siliceous earth, as the fluoric Acid.

The results of the union of this Acid, with the several Earths, will be particularized, when treating of the respective combinations of the Earths. At the same time, those combinations of the other Acids with the Earths, which assume a lapideous form, will be more particularly treated of.

As an examination of the different substances from which the Acids are obtained, cannot but facilitate the knowledge of the nature of the acids themselves, the remaining Acids will be treated of, when the analyses of the respective substances from which they are produced, are described. This is the more necessary, since as several of these Acids appear to owe their existence to certain processes of animal

and

nd vegetable life; these can also be taken into consideration at the same time

METALLIC SUBSTANCES are distinguished y their absolute *opacity*, great degree of *gravity*, and eculiar *brilliancy*; to which may be added their *luctility*, which property, however, is not perhaps ossessed by all metals.

They are concealed in the earth, and form *ores*, hich existing in crevices of rocks, are called *veins*, nd are distinguished into *level*, *inclined*, *direct*, or *blique*, according to the angle they make with the orizon. The part of the rock resting on the ein, is termed, the *roof*; and that on which the ein rests, the *bed of the vein*. When found in pherical parts, or masses, they are called *bellies*, r *stockworks*.

METALS appear to be simple substances. They re *assayed*, and their species ascertained, by he *Docimastic Act*, or *DOCIMASIA*. The meallic part is first cleared, as much as possible, rom the foreign, or stony substances, with which it s blended, and which is called the *Gangue*, by first, educing the ore to powder, in which state it is calld *Slich*, and then by washing. It is then *torrified* o dissipate the Sulphur and Arsenic; and lastly, *used* by the addition of some flux, containing the oaly principle, to disengage the oxygen, with which he metal has been impregnated, during the previous calcination, or torrefaction.

They

They are found. 1. In the form of a Native Metal. 2. In the form of Calx or Oxydes. 3. Combined with Arsenic, or Sulphur. They are fused at a certain degree of heat, and obtain a convex surface, and if suffered to cool slowly, they exhibit crystallizations of considerable regularity. If continued in a state of fusion, they lose their brilliancy, and become an opake Powder, or metallic *Oxyde*, or *Calx*, acquiring weight, and absorbing a certain portion of Oxygen during the transition. If urged by a stronger heat, this is converted into a vitriform substance, or *metallic Glass*.

That Metals are calcined, or rather oxydated, in consequence of their absorbing Oxygen, is proved, by this process taking place, only when Oxygen is present; and by their giving it out in exactly the same quantity and proportion on their reduction, or return to the metallic state. They undergo this process of calcination, or oxydation, also from the action of humidity. The water is decomposed, its hydrogen being dissipated, whilst its oxygen combines with the metal. They are soluble in Acids, and precipitable therefrom by caustic, or carbonated Alkalis; or, Platina excepted, by Prussian Alkali. Acids are decomposed during their combination with metals; their Oxygen combining with the metal, forming a metallic Oxyde: this is either dissolved, and forms a metallic Salt, or the metal is only corroded and the Oxyde precipitated.

If calcined, and not too volatile, they communicate a tinge

tinge to Borax and microscomic Salt, after fusion, r render them opake. When perfectly fused, they re, for the most part, miscible, or combinable vith each other; but, excepting Iron, refuse to mix vith their own Oxydes, or with other unmetallic ubstances, except with Sulphur, Phosphorus, Charcoal, and the Acids.

The names of such Metallic Substances as are at resent known, are

1. Platina
2. Gold
3. Silver
4. Quick-silver
5. Copper
6. Iron
7. Lead
8. Tin
9. Zinc
10. Antimony
11. Bismuth
12. Cobalt
13. Nickel
14. Manganese
15. Uranite
16. Sylvanite
17. Titanite
18. Chrome
19. Arsenic
20. Molybdenite
21. Tungstenite

The four first are commonly called *noble*, or *perect* Metals, because when oxydated, they recover heir metallic appearance by mere heat; but Copper, Iron, Lead, and Tin, cannot be reduced without n addition, and therefore, are called *base*, or *imperect Metals*. Zinc, and the remainder, being either ot at all, or very slightly, malleable, are called *Semi-Metals*. The four last may be changed into Acids, nd may be called *Acidifiable Metals*.

When nature has bestowed on them their proper netallic appearance, or they are only alloyed with other

other metals, or semi-metals, they are said to be *Native*. When combined, as they commonly are in mines, with some unmetallic substance, they are said to be *mineralized*; the substance that sets them in that state, is called a *Mineralizer*, and the compound of both, an *Ore*, which term is applicable when Stones, or Earths, contains metallic substances, whether native, or mineralized in a notable proportion. They are commonly mineralized by Oxygen in its concrete state, to which is often super-added the Carbonic Acid. Next to these, Sulphur, and Arsenic, in its oxydated state, occur; these last generally communicate a metallic lustre. The sulphuric, muriatic, phosphoric, arsenical, and molybdenous Acids, are less commonly met with. They are sometimes united with sulphur, in a calcined, and sometimes in an uncalcined state.

PYRITES are formed, when Metals are united with Sulphur. Thus are formed: 1. TIN PYRITES consisting of Tin and Sulphur. 2. COPPER PYRITES.—Consisting of Copper and Sulphur. 3. ARSENICAL PYRITES—Consisting of Iron and Arsenic. 4. SULPHUR OR MARTIAL PYRITES, or simply PYRITES, or SULPHURET OF IRON, *Sulphur-kies*, consisting of Sulphur and Iron. These last, which are by far the most common, may be divided into

Family—1. SULPHUR, united to Iron *in its metallic state*. Of this there are four varieties:

Variety—1. COMMON SULPHUR PYRITES. *Gemeiner Sulphur-kies*. 2. STRIATED

2. STRIATED. *Strahl Kies.* Werner.

3. CAPILLARY. *Haar Kies.* Werner.

4. MAGNETIC. *Magnetischer eisen Kies.* Werner.

Family—2d. SULPHUR, united to OXYDE OF IRON, and convertible into Hepatic, or brown Iron Ore.

1. HEPATIC PYRITES. *Leber Pyrites. Wasser Kies.*

PLATINA comes to us in a granular state from Peru. It has no known Ore, but is found in a metallic state only among alluvial Gold Ores.

Its colour is between the Tin and Silver White*-2.4: H. 7, 5: Sp. Gr. 20, 6 to 23: being the most ponderous of all known bodies. It is as mal-

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* L. Is meant for LUSTRE, the degrees of which are denoted by figures, 4, marking the higheſt, and 0, dull or without any Luſtre.

T. For TRANSPARENCY, of which the higheſt degree is marked by 4.

F. For FRACTURE.

H. For HARDNESS, the figure 3 denoting the hardneſs of chalk. 4 a ſuperior degree, but yielding to the nail. 5, 6, 7, different degrees of yielding to the knife. 8 too hard to ſcrape with a knife, but does not give fire with ſteel. 9. gives a few feeble ſparks. 10 gives plentiful lively ſparks, like flint.

Sp. Gr. For Specific Gravity.

leable,

leable, ductile, and laminable, as Gold. It is not affected by the action of the air, nor by the heat of an ordinary furnace; but yields to the heat produced by powerful burning glasses, and to that excited by ignited Oxygen Gaz.

It is often mixed with Quicksilver, and Gold, and is intimately combined with Iron, and therefore magnetic. The Mercury may be driven from it by heat, and the Iron may be separated from it by dissolving it in eight times its weight of nitro-muriatic Acid, and either precipitating the Iron, by Prussian Alkali, or the Platina itself by Muriate of Ammoniac. This precipitation of Platina, by the Muriate of Ammoniac, affords a simple method of ascertaining the mixture of this metal with Gold, since the Muriate of Ammoniac has no visible effect on the solution of Gold.

It is soluble in the nitro-muriatic, and the oxy-muriatic Acid; the saturated solution, being of a dark-red-colour. It is precipitable from this solution, by Pot-ash, less freely by Soda, and not visibly by the Prussian Alkali, nor at all, by a dilute solution of sulphate of Iron, which properties distinguish it from Gold. Mr. Berthollet found it in a great measure acidified, when in solution, which accounts for some of its singular properties. The solution deposits small irregular fawn-coloured crystals, the MURIATE OF PLATINA; and if concentrated, it yields larger crystals, sometimes of an octohedral form.—*Bergman.*

It

It amalgamates with *Quicksilver*, and is capable of being alloyed with most of the known metals.

With *Bismuth* it unites easily, and yields a mass of little ductility; with *Antimony*, its fusion is facilitated, but its weight and ductility are lessened, and by *Zinc* it is rendered more fusible, the alloy being very hard.

It unites easily with *Tin*, is very fusible, and unless the Tin is in large proportion, the alloy is very brittle.

It unites very well with *Lead*. One ounce of Platina being cupelled with 20 ounces of Lead, the Platina gains the power of being forged and soldered completely, without the assistance of any other metal. *Baumé*.

It will not unite with *forged Iron*, but melted with *crude Iron*, the alloy is so hard, the file will not touch it; it is ductile in the cold, but breaks short when hot. *Lewis*.

With *Copper*, the alloy is ductile; when the Copper is in the proportion of three or four to one, it takes a fine polish, and does not tarnish in the space of ten years. With *Silver*, the alloy is hard, without ductility, and tarnishes. But with *Gold*, it can only be alloyed by the most violent heat, the colour of the Gold is prodigiously altered, and the alloy possesses considerable ductility.

Platina free from Iron, being fused with Arsenic, or glass of phosphorus, and then separated by

long continued heat, is obtained in a concrete porous form, and may be formed into a solid mass, under the hammer.

GOLD.—Its colour is orange red, or reddish yellow. L. 4. F. Hackley. H. 6. Sp. Gr. 19. 3. Melts at 32°. Wedgwood. It may be volatilized and calcined, in high and long continued heats. It is the most perfect, ductile, tenacious, and unchangeable of all the known metals. Not being combinable with Oxygen, Sulphur, &c. in low heats, it can never be found, strictly speaking, mineralized.

It is found in compact masses, or in spangles; disseminated in various modes, arborescent, capillary, &c. or crystallized in cubic, pyramidal, prismatic, or tabular forms, or in grains, visibly or invisibly mixed with various other substances. The substances in which it is found, are either stony, sandy, earthy, or inflammable, or martial Pyrites, or Ores of other metallic substances. It is also found interspersed in Sand.

It is more extensively diffused, though in exceeding small quantities, than any other metal, except Iron.

It has been obtained from *vegetables*, by Becher. —From *rotted manure*, *garden-mould*, and *uncultivated earth*, by Monsieur Sage.—From *ashes*, by Berthollet,

Berthollet.—Gold may therefore be said to exist n *vegetables*.

When embodied in *calcareous Earths*, or *Stones*, t may be obtained, by adding *Nitrous Acid*, which vill take up the matrix, and leave the Gold unouched. If in *gypseous, or siliceous Earths*, nitronuriatic Acid may be employed, which will dissolve he Gold. It may also be separated from the ore, by mixing it, after pounding and torrefying, with nuriate of Soda, Water, and Quick-silver; the nuriate decomposing the sulphates, formed during he calcination, and the Mercury amalgamating with he Gold, from which it may afterwards be separated by distillation. It may be also separated in the *dry way*, by fusion with Alkali, and sulphure of Alkali, and a subsequent decomposition of the latter by Iron. It may be also separated from most ther metals, by melting the alloy with three times ts weight of Antimony, as the sulphur of the Antimony will scorify most other metals, while the reguline part will unite with the Gold. It is sometimes contained in the form of a brownish red powder, in *Martial Pyrites*. This Ore being roasted, and then digested in dilute nitrous Acid, the Gold may be separated from the sulphur. It is also found in a particular sort of Argentiferous Copper Pyrites, called in Hungary, *Gelf*. It is also found mixed with *Arsenical Pyrites*, and in *Sulphurated Silver Ores*. It is not attacked by the sulphuric Acid, and is very slightly acted on by the nitric

Acid; but is attacked with most energy by the nitro-muriatic Acid, or Aqua Regia, as it is called, and the oxygenated muriatic Acid, which are the true solvents of Gold. This solution yields yellow crystals, resembling topazes, in truncated octohedrons these crystals being a true MURIATE OF GOLD. *Bergman*, *Sage*, &c. The solution tinges animal substances purple, and by distillation, yields a red liquor, called by the Adepts, *The Red Lion*. An Oxyd of Gold is precipitated from this solution, in a *yellow Powder*, nearly in a metallic state, by Lime, Magnesia, and by Alkalis, the precipitate being soluble in the sulphuric, nitric, and muriatic Acids.

When precipitated by Ammoniac from the yellow solution, it is called *Fulminating Gold*, it detonating when gently heated. Fulminating Gold has been proved to be a mixture of Ammoniac, and Oxyde of Gold; the oxygen of the latter, and the hydrogen of the Alkali taking fire by simple heat, detonate; and the gold is restored to its metallic state.

It is precipitated from its solution by several metals, such as Lead, Iron, Silver, Copper, Bismuth, Mercury, Zinc, and Tin. This last precipitates it in a powder, much used in Porcelain manufactories, termed, *The Purple Powder of Cassius*. It may be instantly precipitated, and revivified by Æther, the Gold immediately forming a stratum at the surface of the now colourless liquor. It is also dissolved

dissolved completely by the sulphures of Alkalis, merely by fusing equal parts of Sulphur and Pot-ash, with one eighth of the total weight of Gold in leaves; it may then be poured out, pulverized, and dissolved in hot-water. Stahl affirms, that by this process Moses dissolved the Golden Calf. It may be obtained pure, by precipitation, with a dilute solution of vitriol of Iron, from a solution of Gold, in nitro-muriatic Acid; It unites with most of the other metals; and is rendered brittle by *Arsenic*, as well as by *Bismuth*, *Nickel*, and *Antimony*, and unites well with *Tin*, and *Lead*, but loses all its ductility.

Mr. Alchorne expresses an opinion, that the addition of a very small quantity of Tin to fine Gold, is not so injurious as workmen have imagined. *Phil. Trans.*

But after repeating Mr. Alchorne's experiments, M. Tillet is convinced, that the alloy of a very small quantity of Tin with Gold is injurious, the mixture possessing both hardness and rigidity. (*Mem. de L'Academie*, 1790.)

With *Iron*, it forms a very hard and useful alloy; and by *Copper*, it is made more fusible, and rendered of a redder-colour. This alloy is employed for Coin, Toys, Gold-plate, &c. It is rendered very pale by *Silver*. This alloy forms the green Gold of Goldsmiths. Gold, from its extreme ductility, is drawn into very fine wire, for embroidery, and into leaves of the greatest tenuity, one grain being

being capable of extension over 564 square inches.

When amalgamated with *Mercury*, and applied on Copper, the Mercury may be driven off by heat, leaving a gilding on the surface of the copper. This is the *Or-moulu*.

SILVER is of a pure white. L. 4. H. 6.5. Sp. Gr. before malleation, 10,474: after, 10,510. *Brisson.*

It is malleable, ductile, and laminable, in a high degree, though inferior to Gold; and is not changed by the contact of air. A wire 1-10th of an inch, will support 270 pounds.

It is fusible at 28°, or rather it remains in fusion at that degree, for it requires a higher degree to bring it into fusion*. If by means of solution of *Borax*, a small bit of leaf silver, be stuck to the top of a small glass cylinder, and melted into it, it will give it a golden tinge. *Bergman.*

By long exposure to violent heat, it has been converted into a glass of an olive green colour. In the focus of a burning glass, it yields a white pulverulent matter, but there appears to exist but little affinity between it and oxygen.

When alloyed with *Copper*, it is rendered hard, and fit for silversmiths work, and for coinage. The alloy for the British Coinage, is 11 ounces, 2 pennyweights

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* This distinction is applicable to the degrees of heat, requisite for the fusion of most metallic substances.

ennyweights fine. It combines readily with *Sulphur*, forming SULPHURET OF SILVER.

With *Sulphuric Acid*, if concentrated, sulphureous gas is disengaged, and the silver is converted into a true OXYD OF SILVER, mixed with a small quantity of SULPHATE OF SILVER, in small needles, or in plates formed of these needles, united length-ways.

It is dissolved in *Nitric Acid* with rapidity, and much nitrous gaz is disengaged. The solution is at first, blue, but this colour disappears when the silver is pure, and degenerates into a green, if it be alloyed with Copper. Nitric Acid will dissolve more than half its weight of Silver, the solution letting fall crystals in hexagonal, triangular, or square plates, which are called NITRATE OF SILVER, or *Lunar Crystals*, *Lunar Nitre*, &c.

This melted with a gentle heat, and poured into moulds as soon as fused, forms the *Lapis Infernalis*, or *Lunar Caustic*. It may be precipitated from its solution, by *Lime-water*, *Alkalis*, and several *Metals*.

By fixed Alkalis it is precipitated white; by Ammoniac, grey; and by Lime-water, Olive-green.

It may be precipitated from a dilute solution, by a plate of *Copper*. The Silver adheres like moss to the Copper, and the liquid acquires a blue tinge from the Copper, which is dissolved in the room of the

the Silver. It is likewise precipitated by *Mercury*, with which it will also amalgamate. These crystals, being articulated into each other, give them the form of a vegetation, known by the name of the TREE OF DIANA, *Arbor Dianæ*, &c.

It is readily combined with *the Muriatic Acid*, by adding this Acid to a solution of Silver in the nitric Acid, the MURIATE OF SILVER being precipitated; this muriate, is very fusible, running into a grey and transparent substance, like horn, and is then called LUNA CORNEA, or *Horn Silver*; this being fused with four parts of Pot-ash, the Silver is found in the purest state, under a stratum of sulphate of Pot-ash, and the remaining Alkali. It may likewise be decompounded by several other metals.

Professor Hildebrant says, I have frequently redissolved, in pure nitrous Acid, the Silver which I obtained from Horn Silver, and always found a small quantity of black-powder remaining at the bottom, which seemed to have the properties of Gold. To appearance, part of the Silver is converted to Gold; but the Professor accounts for it, from the Silver, though called pure, containing the Gold thus found.

The Muriate of Silver, exposed to the light of the sun, soon becomes brown, oxygenous gas being disengaged. Nitrated Silver, and most of the solutions of metals, thus emit their oxygen, and become coloured.

Nitrated Silver, being precipitated from its solution,

on, separated from the fluid, exposed three days
the air and light, and mixed with liquid Am-
oniac ; becomes, when dry, *Fulminating Silver*.
his exceeds in power, gun-powder, and even
lminating Gold. Once obtained, it can no longer
touched without a violent detonation, no more than
ne grain being sufficient to give rise to a dangerous
lmination ; after this fulmination, the silver is
und reduced or revivified, its oxygen having
mbined with the hydrogen of the Ammoniac,
Vater, in the state of vapor being produced. This
ater, instantly vapourized, and possessing all the
asticity, and expansive force of that state, is the
rincipal cause of the phenomenon ; in which the
trogen of the ammoniac, with its whole expansi-
lity, bears a part.

Mr. Keir discovered that *a mixture of the Vitrio-
and Nitrous Acids* in a concentrated state, has
peculiar faculty of dissolving Silver copiously,
d at the same time, oxydating Tin, Mercury, and
ickel, dissolving, however, a small quantity of the
tter, and having little or no action on other me-
ls. By dilution, the mixture becomes less capable
dissolving Silver, and more capable of acting on
her metals. *Phil. Transact.* 1790.

QUICKSILVER, is of the colour and lustre of polish-
Silver.—Sp. Gr. 13,568 Brisson, or nearly 13,6.
indestructible by fire as Gold and Silver, and has
erefore been arranged among the perfect metals.

It

It boils, in the same manner, as other liquids whe heated.

It remains liquid between 600° above, an 72° below the freezing point of water on Fahren heit. When congealed by cold, it acquires malleabi lity. Mr. Walker, in the Philosophical Transac tions, for 1795, says, that Quicksilver may be fro zen by a mixture of snow and nitrous Acid, eac being at + 7°.—By ground ice, and nitrous Acid at + 10°. To make it perfectly solid and hard, mixture of diluted sulphuric Acid and nitrou Acid should be used with the powdered ice, bu then the materials should not be less than — 10° be fore mixing.

Mr. W. H. Pepys, assisted by some friends, o the 7th of February, 1799, congealed fifty si pounds of Mercury into a solid mass, by mixture of muriate of Lime, and uncompressed snow, i equal weights. The mass was broken by accident the larger pieces were kept for some minutes befor fusion took place, whilst others were twisted an bent into various forms. Mr. P. describes th sensation he experienced, on laying hold of a piec of the solid Mercury, to be as if he had received wound from a rough-edged instrument, he threw i from him as if it had been a piece of red-hot iron and was not a little alarmed, when he found that th part of his hand which had been in contact with th metal, immediately after lost all sensation, and be came white and dead to the view. From this state i however soon recovered. *Philos. Mag.* Feb. 1799

I

It is but little affected by the air, except by long gitation in it, when it forms a BLACK OXIDE ; but hen acted on by heat at the same time, it gradually ses its fluidity, and at the end of several months, rms a RED OXIDE, called *Precipitate per se*, or *alcined Mercury*.—This Oxide gives out its Oxy- en, by simple heat, one ounce affording a pint, and he Mercury resuming its metallic form. Exposed heat, in close vessels, the oxide sublimes in beau- ful red crystals, and may also be converted into a eautiful RED-GLASS. *Water*, remaining over Mer- ury a considerable time, contracts an evident me- llic taste, and if boiled upon it, is said to acquire vermifugal property; but the Mercury does not ap- ear to be at all changed, or deprived of any part of s weight. The *Sulphuric Acid* acts on Mercury ly if assisted by heat, when sulphureous gaz is sengaged, and a WHITE OXIDE is formed, weigh- g one third more than the Mercury employed ; ot-water being poured on it, it becomes a YELLOW XIDE, called *Turbith Mineral*; the water hold- g in solution, a SULPHATE OF MERCURY, ystallizable in small, soft, and deliquescent eedles.

The *Nitric Acid* dissolves Mercury even without eat, nitrous Gas being disengaged ; one part of the cid oxidating the metal, whilst the other dissolves as it is oxidated. The same thing is observable ring the action of *Sulphuric Acid*, when assisted heat.

The nitric Acid becomes loaded with an excess o
mercurial oxide, which it lets fall on dilution wit
water, and yields crystals, in the form of flat an
acute needles, striated lengthways.—If the solutio
be made in the cold, and left to spontaneous evapo
ration, the crystals are octahedral pyramids, trun
cated near their base, and having the four angles, r
sulting from the junction of the bases of their pyra
mids, likewise truncated; if this same solution b
evaporated, long and acute blades are obtained
striated obliquely across.

The NITRATE OF MERCURY is corrosive; whe
very dry, it detonates upon coals, and emits a brillia
white flame.—Fused in a crucible, or better in a r
tort, it yields oxygen or nitrogen Gases, the r
maining oxide becoming yellow, and at length a liv
ly red, being the *Red Precipitate*, and if fresh n
tric Acid be distilled from it three or four times, th
precipitate is in small crystals of a very superb re
colour. The solution of mercurial nitrate, form
Mercurial Water. It is of use to ascertain the pr
sence of sulphuric and muriatic Salts in mineral w
ters.

From the solution in the nitric Acid, the Mercu
is precipitated in the state of oxide, of different c
lours, by the Acids, Alkalis, Earths, and so
of the metals.—Those by the carbonate of Ammoni
and Lime-water, as well as that of the muriate
Mercury by Lime-water, fulminate when mix
with a small quantity of sublimed sulphur and
pos

osed to heat, leaving a small quantity of a blueish owder, which is a *Sulphuret of Mercury*.

The *Muriatic Acid* does not sensibly act on Mercu-, except by long digestion, when it oxidates a part, hich oxide it dissolves. It completely dissolves ne mercurial oxides, and when these being charged ith a small quantity of oxygen, are nearly in the etallic state, the MURIATE OF MERCURY is rmed. When, on the contrary, the oxide is sa-rated with oxygen, the OXY-MURIATE OF ERCURY, or *Corrosive Sublimate of Mercury* is rmed. This may be obtained either in the dry way, y sublimation from equal parts of nitrate of Mer-ry, or any oxide of Mercury, decrepitated muriate f Soda, and sulphate of Iron calcined to whiteness, r from equal parts of sulphate of Mercury, and ecrepitated muriate of Soda. In the humid way may be obtained by dissolving Mercury in the oxy-enated muriatic Acid, concentration producing ery fine corrosive sublimate. This Salt, placed on ot coals, dissipates in fumes; and in proper essels, rises in flattened prismatic crystals. dded to Lime water, it forms *Phagædenic Water*, yellow precipitate falling;—fixed alkali precipi-tes an orange coloured oxide; and volatile alkali, white powder, which becomes brown in a short me.

To obtain the MILD MURIATE OF MERCURY, *Mercurius Dulcis*, or *Calomel*, equal parts of quick-lver, and of oxygenated muriate, are completely

 blended

blended by trituration, and this mixture exposed to sublimation, yields the mercurius dulcis, which is insipid, in soluble inwater, and if slowly sublimed, forms in crystals of the form of tetrahedral prisms, terminated by tetrahedral pyramids. *Mr. Baumé* remarks that if less Mercury be added, a proportional quantity of mercurius dulcis only sublimes, and the rest rises in the form of corrosive sublimate; and if too much Mercury be added, the excess remains in the form of running Mercury; there being no intermediate state between mercurius dulcis, and corrosive sublimate. By repeated distillations, such a decomposition takes place, as produces corrosive sublimate; the common method of frequent distillations is therefore absurd. To be certain that the mercurius dulcis holds no corrosive sublimate, it should be washed with tepid water. Mercurius dulcis may also be made by subliming the white precipitate made by decomposing mercurial water by a solution of the muriate of Soda.

Borax added to Mercurial water, a yellow precipitate falls, being a combination of the Acid of Borax and Mercury: this Salt forms brilliant crystals by evaporation, the BORATE OF MERCURY. Corrosive sublimate is decompounded by different metals, an amalgam of Tin and Mercury being slowly distilled, a brown liquor is obtained, which, in contact with atmospheric air emits white fumes for a considerable time. This is termed FUMING SPIRIT OF LIBAVIUS; it is a true

rue *Oxygenated Muriate of Tin*, formed in con-
equence of the oxygenated muriatic Acid quitting
ie Mercury and uniting to the Tin.

The acetous Acid dissolves the oxides of Mercury,
ffords white foliated Crystals, the ACETATE of
IERCURY. Mercury precipitated from the solution
f the *Acetate of Mercury*, combines with the aci-
ulous tartrite of Pot-ash, and forms the *Vegeto-
lercurial Water* of Pressavin. The acetate of Mer-
ury is the basis of *Keyser's Pills*.

Mercury mixed with *Sulphur*, forms the RED OR
LACK SULPHURATED OXIDES, the *Æthiops* or
innabar.

Four ounces of sulphur may be triturated with
velve ounces of sublimed sulphur, or four ounces
f sulphur may be fused in a crucible, and one
unce of Mercury extinguished in it, or the sulphur
f Pot ash may be added to mercurial water.
y all these means the *black Sulphurated Oxide of
lercury*, or mineral Æthiops is formed.

By subliming these Æthiops, the *Red Sulphurat-
d Oxide* of Mercury is obtained, called also *Cinna-
ar*.

The Count Appollos de Moussin Pousschin pre-
ared a beautiful cinnabar by triturating Mercury,
nd Flowers of Sulphur, with a solution of caustic
egetable Alkali, keeping it at a proper temperature,
nd afterwards washing it repeatedly by boiling-
ater, which carries off a small portion of Æthiops,
ot sur-composed.

Nicholson's Journal.

Mercury amalgamates with most other metals: on this property is founded the art of gilding. Mercury is also employed in Painting, in forming mirrors, philosophical instruments, &c.

COPPER is of a pale muddy red, with a shade of yellow, malleable, flexible, and ductile, though inferior in these respects to Silver. H. 8. Sp. Gr. 7,780. to 9,324. A wire 1-10th of an inch, will support 299½ pounds. It melts at 27° Wedgwood. Exposed to the fire, it becomes blue, yellow, and at last, violet. When in contact with the coals, it gives a greenish blue tinge to the flame, and if kept long in fusion, part is volatilized. Heated in contact with air, it burns at its surface, and becomes changed into a *blackish red oxide*, which by a more violent heat, is converted into a *brown glass*.

It combines readily with sulphur, forming a very fusible mass, termed SULPHURET OF COPPER.

It is only acted on by the *Sulphuric Acid*, when concentrated, and very hot. It then dissolves it, and affords blue crystals of a rhomboidal form, being the SULPHATE OF COPPER, *Blue Vitriol*, *Cyprian Vitriol*, *Blue Copper*, &c. Lime and Magnesia precipitate the Copper of a blueish white, as well as Ammoniac; but the precipitate from this, is dissolved at the instant it is formed, and the result is a beautiful blue liquor, called *Aqua Cœlestis*.

Ammoniac dissolves both the Copper and its oxides, the solution is of a beautiful blue, the colour disappearing

lisappearing in closed vessels, and returning on ex-
osure to the atmosphere. The Sulphate of Copper,
ontains in 100 parts: 30 Acid, 43 Water, 27 Copper.

It is attacked by the *Nitric Acid* with effervescence,
bundance of nitrous gas being emitted. The Acid
eing diluted, a blue solution is obtained, yielding
rystals of NITRATE OF COPPER, in long parallel-
grams, or colourless rhomboidal crystals.

It is not dissolved by the *Muriatic Acid*, unless
oiling and concentrated. The solution is green,
nd affords prismatic crystals, the MURIATE OF
OPPER, of a grass green. Ammoniac does not
issove the oxide of this muriate, with the same fa-
ility as that of other cupreous salts. When acted
n by the *Acetous Acid*, it is corroded, and yields
ie substance, known by the name of *Verdegris*.
eing combined with oxygen, it becomes more readily
oluble in vinegar. The oxide of Copper dissolved
n vinegar, forms the ACETITE OF COPPER, *dis-
lled Verdegris*, or *crystals of Venus*. Vinegar dis-
lled from Manganese, dissolves Copper from the
xygen it has taken up: and the *Acetic Acid*, or
adical Vinegar, dissolves Copper by its greater
uantity of Oxygen., forming the ACETATE OF
OPPER. The blue solutions of Copper, indicate
ie less, and the green, the greater degree of oxy-
enation. *Morveau.*

By pouring the acetite of Lead on a solution of
ulphate of Copper, sulphate of Lead is produced,
hich is precipitated, and Acetate of Copper, which
remains

remains in solution, and will yield beautiful crystals of verdegris. *Chaptal.* *Annales de Chimie.*

Alkalis, and even many neutral salts act on it, though but slightly, and it is said, most powerfully in the cold, and when exposed to the atmosphere.

It is precipitated in its metallic form, by a clean plate of Iron, appearing to convert the Iron into Copper. The Copper thus obtained, is known by the name of COPPER OF CEMENTATION.

It mixes with most of the metals and semi-metals, forming 1. With *Arsenic*, the WHITE TOMBAC. 2. With *Bismuth*, an alloy of a reddish white colour, with cubic facets. 3. With *Antimony*, a violet coloured alloy. 4. With *Zinc*, by fusion, the SIMILOR, OR MANHEIM GOLD; or by cementation with *Calaminaris*, BRASS. 5. In a solution of *Quicksilver*, it acquires a white surface from the precipitation of the Quicksilver. 6. It easily unites with *Tin*; on this depends the art of tinning. Fused with Tin it forms BRONZE or BELL METAL. (Dr. Pearson having examined some ancient metaltic arms and utensils, was able to ascertain that they consisted of Copper and Tin, in the proportion of from six to twelve parts of Copper to one of Tin, according to the use for which they were intended.) 7. With *Iron* it contracts very little union. 8. Alloyed with *Silver*, it is rendered more fusible; these two metals are combined to form solder. 9. Added to *Gold*, the Gold is hardened, and its colour heightened. It precipitates Silver from its solution

in

in the nitric Acid. This method is used to separate the Silver after the operation of parting.

It is employed for various domestic uses. Its oxide is employed to colour glass of a beautiful green.

IRON, when fresh broken, is of a pale, somewhat blueish grey. L. 3: T. 0: H. 8 to 9: of Steel. 11: Sp. Gr. of cast Iron, from 7,2 to 7,6: of bar Iron, from 7,6 to 7,8: of Steel, from 7,78 to 7,84: being the lightest of all metals except Tin. It is the most generally diffused metal in nature: almost every mineral substance deriving a colour from it, from the blue to the deepest red; animal substances contain it, and it exists in the vegetable kingdom; even in vegetables supported merely by air and water. It is so ductile as to be capable of being drawn into wires of extreme fineness. A wire 1-10th of an inch will support 450 pounds.

It is obedient to the magnet, and gives fire with quartz, and is the only metal capable of combustion on collision. It is difficult of fusion, but may be hammered with heat into any form. When slowly cooled, it crystallizes into octahedrons almost always implanted one in the other. It is easily oxidated. On being heated in a furnace for some time, the surface is oxidated, and separates in the form of scales.

This oxide of Iron, when most degraded, and of a reddish brown colour, is the BROWN OXIDE OF IRON, formerly called the *Astringent Saffron of Mars*. The colour varies with the degree of oxidation.

tion, becoming yellow and even red; and is reduced to a black powder, by heating it with coaly matters.

Exposed to the action of air and water as in a humid atmosphere, Iron rusts speedily, its surface being changed into a MARTIAL OXIDE, called formerly the *Aperitive Saffron of Mars*, by the combination of oxygen and carbonic Acid with the Iron. This preparation is therefore not only an Oxide, but a CARBONATE OF IRON.

Iron in filings, being constantly agitated in water, a black powder is deposited, being a BLACK OXYD OF IRON, also called the *Martial Æthiops of Lemery*. The oxidation is effected by the air contained in the water, but more especially by the decomposition of the water itself, hydrogen gas being developed during the process. It is oxidated in a slight proportion, by being digested in a solution of the *fixed*, or *volatile Alkalis*, falling down in the form of an Æthiops.

The *concentrated Sulphuric Acid* is decomposed by boiling on this metal. If the mixture be distilled to dryness, the retort will be found to contain sublimed sulphur, and a white mass partly soluble in water, but incapable of crystallization.

The *diluted Sulphuric Acid* being poured on Iron, a considerable effervescence arises in consequence of the disengagement of the hydrogen gaz of the water, its oxygen being employed to calcine this metal, whilst the Acid dissolves the metal without being

being decomposed. This solution when concentrated, yields by evaporation, the SULPHATE OF IRON, also called *Sal Martis*, *Vitriol of Iron*, *Salt of Steel*, or *Copperas*.

Iron when fused may be cast into suitable moulds, in which state it is called *Cast Iron*. If instead of this it be stirred when in fusion, and then carried to the forge hammer, and hammered into bars, it assumes a fibrous texture, and becomes more ductile: in this state it is called *Bar Iron*. If placed in contact with coaly substances, and softened to such a degree, that these may penetrate into its texture, a substance is formed possessing a greater degree of hardness and elasticity than either of the former, and is then termed *Steel*.

These three states appear to be modifications of the same substances.

CAST or CRUDE IRON, contains *Carbon* and *Oxygen*. The presence of the former appears from its coating the utensils, employed in its fusion, with *Plumbago*, a substance which contains nine tenths of carbon: also from the Acids which dissolve it always a leaving a residue, which is purely carbonaceous. That crude Iron contains oxygen, is rendered evident by the for mation ofcarbonic Acid, by urging the crude Iron, in close vessels, in a violent heat.

Crude Iron may exist in three states, white, grey, or black, according as it contains a larger proportion of carbon, an exact proportion of carbon and oxygen, or a larger proportion of oxygen.

STEEL

STEEL is a kind of Iron containing *Carbon* only, it may be impregnated with this. 1. During the fusion, which happens when the Iron is contained in the ore in nearly a disengaged state, and a large proportion of coal is employed; the Iron being scarcely at all calcined, becomes charged with carbon only, the result being Steel. 2. Afterwards, by the cementation of Iron in a ductile state, and free from all foreign matters with coally substances, the Iron in both these cases passing into the state of Steel, or CARBURET OF IRON.

The nature of the combination producing Steel, will plainly appear from Steel kept plunged for a considerable time in crude Iron, abounding with oxygen, being converted into soft Iron. Soft Iron on the other hand, kept for a time in crude Iron, in which carbon predominates, is converted into Steel.

Iron may contain a much greater quantity of carbon than is necessary as a constituent part of Steel; in this state it is hard and unmalleable, and may be called HYPER-CARBURET OF IRON.

Dr. Pearson. Phil. Trans.

Clouet has observed that 1-32 of Charcoal is sufficient to convert Iron into Steel; and that 1-6th affords a Steel more fusible, but still malleable. After this it comes nearer to the state of cast Iron, and by augmenting the dose of charcoal, the fusibility is increased, and at last it acquires the state of *Grey Cast Iron*.

By

By the addition of *Glass*, though but a small quantity enters into the Iron, its properties are much changed. Though soft to the file, yet if heated cherry red, it flies to pieces under the hammer. The cast ingot contracts in cooling. When by careful management it is made into bars, by hardening they acquire the grain of Steel. By adding from 1-30 to 1-20th of charcoal, it may be forged at a red-heat, and gains all the properties of cast Steel; but by adding more, only a cast Iron is obtained.

The attraction of Iron for carbon is such, that, at a very high temperature, it will even take it from oxygen, thus Iron urged in a welding heat, with carbonate of Lime and Clay, is changed to Steel. One fifth of cast Iron, converts Bar-Iron into Steel. The black oxide, with half the quantity of charcoal which would serve for its reduction, affords a black Iron of little tenacity. One sixth of the oxide restores common Steel to the state of Iron.

Annales de Chimie, 1798.

Dr. Pearson, by an ingenious investigation of the nature of a kind of Steel, called WOOTZ, which is brought from Bombay, discovered that it contains oxygen, and concluded, from all the properties it posseses, that oxygen is the ingredient which distinguishes Wootz from Steel.

Philos. Trans.

Mr. Mushet, on the suggestion of the Editor, observes that carbon exists in steel, in a concrete state,

though

though not crude,—in chemical union, however, and not in mere mixture, as in crude Iron.

Philos. Mag.

FORGED IRON is distinguished into *soft Iron*, and *cager or brittle Iron*. This last has a coarser grain than the other, and is divided into *red short Iron*, and *cold short Iron*.

RED SHORT IRON, which is malleable when cold, but brittle when Ignited, is supposed to derive these properties from Arsenic.

Vander Monde, Monge, and Berthollett.

COLD SHORT IRON which is brittle when cold, but not when ignited; being dissolved in the sulphuric Acid, precipitates a *white Powder*, supposed by *Mr. Bergman*, who discovered it, to be a peculiar metal, this precipitate he named SIDERITE; but *Mr. Meyer*, of Stetin, has proved it to be a true PHOSPHATE OF IRON, or combination of *Phosphoric Acid* with Iron. This may likewise be obtained, by dissolving the Iron in the nitric Acid, and evaporating to dryness, by which the Iron is oxidated; more nitric Acid being then added, the siderite is only dissolved, the oxide being left untouched. A second evaporation being made, and the residue diluted with water, to evaporate the last portions of nitric Acid, that which remains is Siderite. This is soluble in the sulphuric, nitric, and muriatic Acids, from which it may be precipitated by as much alkali as will saturate the Acid solvent; the result is a phosphate, and a neutral salt, from the Acid

Acid and Alkali employed. If more Acid be added, no ochre is precipitated, which affords Iron by reduction. The fixed and volatile Alkalis, and Lime-water, decompose Siderite. It is likewise decomposed by projection on fused nitre. When precipitated by ammoniac, crystals may be obtained by evaporation, which when treated with powder of charcoal afford phosphorus.

Every solution of Iron is precipitated in the form of Siderite, by the phosphoric Acid.

The tempering of Iron, effected by suddenly cooling it after heating, seems to produce its hardness, brilliancy and brittleness, by the integrant parts, separated by the heat, being kept and left at a certain distance from each other, the sudden cold checking their approximation by the affinity of aggregation.

Ever since the invention of *cast Steel*, it has been supposed to be impossible to *weld* it to either common Steel or Iron, but *Sir Thomas Frankland* says, the fact is, that cast-Steel in a *white heat*, and Iron a *welding heat*, unite completely.

Philos. Trans. 1795.

I. Crude, cast, or pig Iron, is eager and brittle, and contains Iron, Carbon and oxygen, the carbon being in a concrete state separable by mechanical division. Its varieties are:

1. Oxygenated crude Iron, contains a small proportion of carbon, and a super-abundance of oxygen, is called *white-Iron*, *forge-pigs*, *ballast-Iron*, &c.

2. Carbo-oxygenated crude Iron, contains equal

quantities of carbon and oxygen; known by the name of *grey-Iron*.

3. Carbonated crude Iron,—Carbon fully predominating with an extra privation of oxygen.

4. Super-carbonated crude Iron,—approaching to and even becoming a true plumbago.

II. Malleable Iron.

1. Hot short Iron—from concrete carbon, not extirpated during the operation for making the Iron malleable.

2. Cold short Iron, becomes more and more cold short, by exposure to the combination of oxygen with caloric by blast, or the attenuated heat of a wind furnace.

3. Pure malleable Iron deprived of the principles which constitute the two former kinds.

STEEL is a mixture of Iron with carbon in an aëriform state; by the combustion of its base when properly hammered, it becomes elastic. It is also capable of fusion, by which it becomes cast Steel, and of acquiring a greater degree of hardness by immersion, at certain degrees of heat, into cold water.

Musbet. Phil. Mag.

Dr. Beddoes observes, that in the conversion of cast into malleable Iron, in the reverberatory furnace,—the oxygen of the imperfectly reduced metal, combines with the charcoal to form fixed air; at the same time another portion of charcoal is thrown into an elastic state, that is, into inflammable air, and burns on the surface with a very deep blue flame, on account

account of the admixture of fixed air.—By subsequent experiments, the Doctor ascertained beyond doubt, the real extrication of air, varying in its nature at various periods of the process.

Philos. Trans. 1791.

The mass of Iron, weighing 1600 pounds found in Siberia by Pallas, is supposed by Dr. Chladni, to have been a fire-ball or shooting star, and that Iron is the principal matter employed in forming new planetary bodies.

A drop of nitrous Acid placed on polished Iron and washed off, leaves a white spot. On polished Steel it forms a black spot, by the coaly part which is deposited during the solution of the Iron.

PLUMBAGO, is that shining substance of a blackish blue colour, which is used to make the pencils called *Black Lead Pencils*; it has a greasy feel, exhibits a tuberculated fracture, soils the hands, and leaves a black trace upon paper. It is indestructible by heat without the presence of air, but with the concurrence of air, it burns, and leaves but a small residue.

One part of Plumbago, and two of caustic dry Alkali, being heated in a retort, the Alkali effervesces, hydrogenous gas is formed, and the Plumbago disappears. The small quantity of water in the salt is decomposed, whence the hydrogen gaz; and its oxygen combining with the carbon of the Plumbago, forms carbonic Acid.

The *Sulphuric Acid* distilled from Plumbago, passes

passes to sulphureous Acid, carbonic Acid being yielded, and an oxide of Iron left in the retort.

The *Nitric Acid* has no action upon Plumbago, if pure.

The *Muriatic Acid* has no action upon Plumbago; but, as it dissolves the Iron and Clay, which contaminate it, it is used for its purification.

The *Oxygenated Muriatic Acid* dissolves it; the result being a true combustion effected by the oxygen of the Acid, and the carbon of the Plumbago.

If thrown by little at a time on fusing *Nitrate of Pot-ash*, the Salt will deflagrate, and the Plumbago be destroyed; the residue being a strongly carbonated Alkali, and a small portion of martial ochre. All these facts prove that Plumbago is a peculiar combustible substance, a true charcoal combined with a martial basis. It is more common than is imagined. The brilliant charcoal of certain vegetable substances, especially when formed in close vessels, possesses all the characters of Plumbago. The charcoal of animal substances possesses characters still more resembling it: being difficult to incinerate, leaving the same stain, containing Iron, and becoming converted into carbonic Acid by combustion. During the distillation of animal substances by a strong fire, a fine powder attaches itself to the neck of the retort, which may be made into excellent pencils.

Carbon may be formed in the earth by the decomposition of wood, together with pyrites; but the origin

origin of Plumbago seems to be principally owing to the ligneous, and truly indecomposable part of the wood, which resisting the destructive action of water, in its decomposition of vegetable substances, is disengaged from the other principles, and forms peculiar depositions, and strata. *Chaptal.*

In the dominions of the King of Naples, there are wells dug expressly for the purpose of collecting an acidulous water, at the bottom of which, a quantity of Plumbago is collected every six months. *Fabroni.*

The same gentleman supposes the black mud found beneath the pavement of Paris, is Plumbago formed in the humid way.

Plumbago is used for Pencils, for lubricating the surfaces, and thereby lessening the effect of friction of certain parts of machines, for defending Iron from rust, for polishing, &c.

The nature of *Plumbago* has received considerable illustration, from some late experiments and observations on the DIAMOND. *Newton* conjectured the diamond to be a combustible body. *Guyton* in 1785 inferred its similarity to charcoal, from its leaving an effervescent Alkali, after combustion in fused nitre. *Lavoisier* found that on burning it in closed vessels, it yielded carbonic Acid. This has also been proved by *Mr. Tennant*, who performed the combustion in a crucible of Gold. *Berthollet* considered it as *crystallized Charcoal.*

Since this, *Guyton* having burnt the diamond in oxygen

oxygen Gas, by the solar rays, and thereby having obtained carbonic Acid without residue, has ascertained the diamond to be *Pure Carbon*, or the *pure combustible matter of the carbonic genus*, yielding the *pure acidifiable bases of the Carbonic Acid*. He found its combustion required a much higher temperature than charcoal; but this he observes, takes place with other acidifiable bases, their first degrees of oxidation being difficultly produced, although their subsequent acidification is easy. It also required more oxygen for its complete combustion than charcoal; this he remarks is not to be wondered at, since being pure carbon, it contains none of the oxygen principle, and therefore demands more. One part of diamond absorbed four of oxygen, and produced five of carbonic Acid. In proportion therefore as substances contain pure combustible matter, will, in fact, be the difficulty of their combustion, their first degrees of oxidation proceeding so slowly. Thus he accounts for Plumbago, which is a carbonic combustible, richer in combustible matter than charcoal itself, not burning but at a very high degree of temperature: and thus he accounts for the incombustibility of Anthracolite, Kilkenny coal, the brilliant charcoal above-mentioned, &c. The diamond is therefore to be considered as pure carbon—Plumbago, carbon oxidated in the first degree;—Charcoal, an oxide of the second degree, and carbonic Acid, the result of the complete oxygenation of carbon.

From the foregoing experiments, *Clouet* was induced

duced to propose the conclusive experiment of making *soft Iron* pass to the state of *Steel*, by *cementation with the Diamond*. He therefore secured a diamond with some filings of Iron, in a cavity bored in a block of soft Iron, filling up the cavity with a stopper of Iron. The whole properly enclosed in a crucible was exposed to the heat of a blast furnace, by which the diamond disappeared, and the metal was fused, and converted into a button of cast steel.

Mr. Mushet having repeated the experiment of *Clouet*, but on the suggestion of the Editor of the Philosophical Mag zine, *keeping out the Diamond*, found the Iron converted into steel, and therefore supposes the conversion would have taken place in the experiment of *Clouet*, if no diamond had been employed. The experiment was proposed in consequence of *Mr. Mushet* finding reason from his experiments, to reject the idea of carbon necessary to the conversion of Steel being obtained by the decomposition of carbonic Acid.

It combines easily with sulphur by fusion, forming a *true martial Pyrites*.

By the combination of the SULPHUR with Iron, in the bowels of the earth, are formed the *Sulphureous Iron Ores*, the *Martial Pyrites*, or SULPHURETS OF IRON. These sulphures are very abundant, and are evidently formed by the decomposition of vegetables. *Chaptal*.

The sulphures of Iron crystallize sometimes in cubes, and often in octahedrons. The union of a number

number of octahedral pyramids, forms the GLOBULAR PYRITES.

From the decomposition of pyrites, the sulphuric Acid is disengaged, which holding the Iron in solution, forms the SULPHATE OF IRON, or *Copperas*, of which we have just before spoken. It crystallizes in rhomboids of a beautiful green colour, of which it is deprived by exposure to the air, from its efflorescing, and losing its water of crystallization; exposed to heat, it liquifies, becomes thick, and is reduced to a powder. This powder mixed with pulverised nutgalls, forms *Ink-powder*, only requiring the addition of water to render it fit for use. The same powder urged by stronger heat, loses all its sulphuric Acid, a *martial Oxide*, named *Colcothar* remaining.

It may be also precipitated by the *carbonate of Pot-ash*, and re-dissolved by the superabundant Alkali, forming the *martial Alkaline tincture of Stahl*. Or if it be precipitated by caustic Alkali, the Æthiops is formed at once. *Maret*.

It is attacked by the *diluted muriatic Acid* with vehemence, hydrogenous gas being disengaged from the water. By concentration, a *magma* containing thin flatted deliquescent crystals is formed, being a MURIATE OF IRON. This distilled, first yields an Acid phlegm, then a non-deliquescent muriate of Iron, and very transparent crystals in the form of razor-blades, shewing prismatic colours, are sublimed; there remaining at the bottom of the retort, a styptic deliquescent Salt of a brilliant colour, and

foliated appearance, like fine large talc. This again by sublimation yields an opake, metallic substance, polished like Steel, exhibiting sections of hexahedral prisms, being Iron reduced.

Iron is precipitated from its solutions, by the *Acid of Galls*, this forming the BASIS OF INK.

It is dissolved by the *vegetable Acid* with facility. This holds the metals suspended in vegetables, it being precipitable from Wine in the form of Æthiops, by the means of pure Alkalis. It is likewise dissolved by the *acidulous tartrite of Pot-ash*, forming the SOLUBLE MARTIAL TARTAR, or *Aperitive extract of Mars*. In the *oxalic Acid*, it yields prismatic, astringent, effervescent crystals of a greenish yellow colour, soluble in water.

With the *Prussic Acid*, it forms PRUSSIATE OF IRON, or *Prussian Blue*. If the oxide of Iron predominates in this combination of Iron, and the prussic Acid, the precipitate is yellowish; but if its proportion be less, the product is prussian blue. The prussiate of Iron is decomposed by the oxide of Mercury. Prussiate of Iron takes fire more easily than sulphur, and detonates strongly with the oxygenated muriate of Pot-ash. Lime water saturated with the colouring principle by digestion on Prussian blue, is the most accurate means of ascertaining the presence of Iron, precipitating it of a fine blue.

Iron in filings, with an equal quantity of *nitrate of Pot-ash*, thrown into a crucible strongly ignited, detonates, emitting numerous bright sparks, the residue, when

when washed, being a YELLOW OXIDE OF IRON, called *Zwelfer's Saffron of Mars*.—Iron decomposes the muriate of ammoniac, very well, yielding an aeriform fluid, half Alkaline, and half hydrogenous. Iron, in filings, sublimed with muriate of ammoniac, in the proportion of an ounce to a pound, forms the MARTIAL FLOWERS, or *Ens Martis*, being a MURIATE OF AMMONIAC COLOURED BY AN OXIDE OF IRON. The filings mixed with sulphur, and moistened with water, become heated in a few hours. The water is decomposed, the Iron rusts, the sulphur is converted into Acid, the hydrogenous gas exhales, and the heat is sometimes sufficient to set the mixture on fire. By this process is produced the *Volcano of Lemery*.

Oxides of Iron give a pale green Glass, with microcosmic Salt, and also with Borax, but so much the more inclining to yellow, as they are more oxygenated.

When after oxidation, it contains less than 24 per cent of oxygen; it is strongly attractible by the magnet, and more or less soluble in nitrous Acid, inversely to its proportion of oxygen. If it contains from 24 to 28 per cent. it is weakly magnetic, and insoluble in that Acid without particular management. If it contains above 30 per cent. it no longer obeys the magnet, nor is it acted upon by the nitrous Acid.

It may be alloyed with several metallic substances

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ɔut the only alloy which is used in the arts, is that which it contracts with Tin, by which, *Tin plates* ire formed.

LEAD is of a blueish white, L.3. H.5. Sp. Gr. 1,352. It gives a black mark to paper, or the fingers; is the least sonorous, tenacious, and elastic of metals. It quickly tarnishes, its surface soon becoming oxidated or rather carbonated, and may be passed among the most fusible of metals. It affects the organs both of smell and taste. It melts before becomes red hot, at 540° Fahrenheit. In a cupelling heat it evaporates and loses from 6 to 8 per cent of its weight. *Abbe Mongez* obtained it in quadrangular crystals, recumbent on one side. Kept for some time in fusion, it becomes covered with a GREY OXIDE, which again exposed to a more violent heat, assumes a deep yellow, and is called *Massicot*. This boiled by the effusion of water, ground and washed from the particles of lead, and again exposed to considerable heat, becomes RED OXIDE OF LEAD, called *Minium*.

If the fused Lead is exposed to violent heat, and the wind of bellows directed on its surface, a scaly yellow oxide is formed, called *Litharge*.

These oxides being fused with coaly matter, the metal is revived; if distilled by a strong heat, oxygen gas is separated; and if urged by a very strong

heat, they are converted into a YELLOW GLASS; so fusible that it penetrates the best crucibles. It assists the fusion of Glass, and renders it of a more unctuous feel, more soft and ponderous, and more capable of being cut and polished.

Sulphuric Acid being boiled on Lead, much sulphuric Acid rises, and an oxide of Lead is formed, as well as a very caustic SULPHATE OF LEAD, which dissolves in water, and crystallizes in tetrahedral prisms.

Hot *Sulphureous Acid* corrodes the Lead instantly.

Concentrated *Nitric Acid* also converts it into a white oxide; but when the Acid is weak, the Lead is dissolved, and crystals of an opake white in the form of segments of a three sided prism, may be obtained, being the NITRATE OF LEAD.

The *Muriatic Acid* assisted by heat, oxidates Lead and dissolves a portion. This salt, the MURIATE OF LEAD, crystallizes in striated hexahedral prisms which are slightly deliquescent.

The muriate of Lead is also formed by adding the muriatic Acid to a solution of a nitrate of Lead, the oxide combining with the muriatic Acid, and precipitating in a white powder, called *Plumbum Corneum*.

The oxides of Lead are all decomposable by the muriatic Acid. It decomposes Litharge of Lead instantly, fifty or sixty degrees of heat being produced, the solution yielding fine opake, white, octahedral crystals, of a considerable weight, soluble in less than their weight of boiling water. They decrepitate

ate on hot coals, and by an increased heat, are converted into a mass of a beautiful yellow colour. By somewhat similar combination is obtained, the fine YELLOW PIGMENT, called PATENT YELLOW, which may be also produced by the fusion of litharge and common salt. Minium or litharge also decomposes the *Muriate of Ammoniac*; and, by their decomposing *Sea Salt*, the separation of soda is obtained.

The *Acetous Acid* corrodes Lead, and affords a white oxide, known by the name of WHITE LEAD.

All the oxides of Lead are soluble in vinegar, forming the ACETITE OF LEAD, which crystallizes in efflorescent tetrahedral prisms, formerly called *Salt of Saturn* or *Sugar of Lead*.

The oxides of Lead attract the *Carbonic Acid* of the atmosphere with great eagerness.

Caustic Alkalis dissolve the oxides of lead, which may be precipitated by Acids; and, in a metallic form, by mere concentration; the Alkali acquiring a peculiar faint taste. Pure Alkalis added to a solution of the muriate of Lead, a magma is directly formed, occasioning a species of *Miraculus Mundi*.

Sulphur combines readily with Lead, forming a brilliant semi-crystallized mass, termed SULPHURET OF LEAD.

Besides its other uses, Lead is employed to glaze pottery; its oxides enter into the composition of glasses, crystals and enamels, and also form pigments. They are also used to amend the appear-

ance and taste of Wines and brandies; and to harden oils, and render them more drying. Dissolved in oils, they serve as the basis of plasters.

To detect the admixture of Lead in Wine, equal parts of oyster-shells and crude sulphur, may be kept in a white heat for fifteen minutes, and when cold, mixed with an equal quantity of Acidulous tartrite of Pot-ash, and put into a strong bottle with common water to boil for an hour; and then decanted into bottles holding an ounce each, with 20 drops of muriatic Acid in each. This liquor precipitates the least quantities of Lead, Copper, &c. from wines in a very sensible black precipitate.

M. Harbemaun. Bibl. Phys, Eon.

TIN is of a silver greyish white. L. 3. H. 6. very soft. Sp. Gr. of Cornish Tin, melted and not hammered 7,291. hammered 7. 299. It is the lightest of all metals; is exceedingly ductile, but inconsiderably tenacious. It is very flexible, and crackles when bended. It fuses at 410°: during its fusion, the surface, exposed to the air, is soon covered with a pellicle of WHITE OXIDE, called *Putty*, used to polish hard bodies, and convert Glass to *Enamel*.—Kept in fusion eight or ten hours in a lined crucible, and in contact with charcoal, it becomes more white, hard,

hard, and sonorous. It takes fire with a violent heat, a white oxide subliming, and part of the Tin being converted into a Glass of an hyacinthine colour. *Geoffroy.*

After repeated fusions, an assemblage of prisms are obtained, united together sideways. *De la Chenaye.*

It is dissolved in *Sulphuric Acid* in a strong heat. Water is sufficient to precipitate this oxidated metal. *Mr. Monnet* has obtained crystals, which resembles fine needles, interlacing each other. The oxide is dissolved much better by the *Sulphuric Acid.*

In the *Nitric Acid* it is directly precipitated in a white oxide.—If saturated with the Tin, and the oxide washed with a considerable quantity of water, a salt, THE NITRATE OF TIN, is obtained.

This nitrate burns with a white and thick flame like that of phosphorus ; and detonates when well heated into a crucible. On distillation it boils up, and fills the receiver with a white vapour smelling like nitric Acid.

By adding a solution of Gold to the solution of Tin in the nitric Acid, a beautiful purple precipitate falls.

Tin is dissolved by the *Muriatic Acid*, cold or heated, a fetid gas being disengaged. The solution is yellowish, and the MURIATE OF TIN crystallizes in needle like forms, and attracts humidity.

When amalgamated with one fifth of Mercury,

and distilled with an equal quantity of the whole; of corrosive sublimate, an insipid liquor first comes over, and then white vapours, which condense into a transparent liquor, that emits a considerable quantity of vapours, by mere exposure to the air. This is the smoking liquor of Libavius; appearing to be an OXYGENATED MURIATE OF TIN.

It is dissolved by the *Oxi-muriatic Acid* with vehemence, and when the Acid is highly concentrated, a magma is obtained, resembling Pitch, which hardens in time.

It is dissolved in the common *Aqua-fortis*, prepared with Salt-petre of the first boiling, for the composition for scarlet dye, from *Cochinelle*. This solution often disappoints, from the variable proportions of the muriate of Soda, and nitrate of Potash; when it contains too little muriate, a precipitate falls; and when the Acid is in excess, it affords an obscure colour. The most accurate proportions for a good solvent of Tin, are two parts of nitric, and one of muriatic Acid.

It is likewise slightly soluble in the *vegetable Acids*.

Combined with *Sulphur*, it forms SULPHURET OF TIN, or *Aurum Musivum*, or *Mosaic Gold*. Eight ounces of Tinand of Mercury being amalgamated together, are put in a mattrass with six ounces of sulphur and four of muriate of Ammoniac; the bottom of the mattrass being ignited, the sulphuret sublimes; and if the heat is such as to make the mixture take fire, it is sublimed of a dazzling colour in a large hexagonal

nal Scales. It may be prepared without either Mercury or muriate of Ammoniac, from eight ounces of Tin precipitated by the carbonate of Soda, from its solution in the muriatic Acid, mixed with four ounces of sulphur.

A precipitate from the nitrate of Tin, by liquid sulphure of Pot-ash being dried, and put into a retort, with half its weight of sulphur, and a quarter of the muriate of Ammoniac, the sulphuret of Tin will be formed at the bottom of the retort, and of a most brilliant appearance. *Brugnatelli.*

Being amalgamated in the proportion of two ounces to a pound of *Mercury*, and urged by a violent heat for five hours in a sand bath, no Mercury was disengaged, but the Tin was crystallized; the lower part of the amalgam being composed of grey brilliant crystals in square plates, thin towards their edges, leaving polygonal cavities between each. Every ounce of Tin retaining in crystallization three ounces of Mercury. *Sage.*

It may be combined with other metals in various proportions. The malleability of *Gold* is impaired even by an exposure to its fumes. *Silver* also suffers a diminution of its malleability by being fused with it. When alloyed with *Copper*, it forms BRONZE or BELL-METAL; with a very small proportion of *Iron* it becomes harder, and more sonorous.

Three parts of *Tin*, with five of *Bismuth*, and two of

of Lead, forms an alloy, which has been termed the SOFT SOLDER, it liquifies in boiling water. *Lichtenberg.*

One part of Tin and one of Zinc being melted together, and mixed with two of Mercury, then agitated in a box rubbed with chalk, forms an amalgam which wonderfully augments the power of electrical machines. *Kienmayer.*

Its amalgamating with *Quicksilver*, occasions its being employed in the formation of mirrors.

When combined with *Lead* and *Antimony*, it forms a mixture called PEWTER, very generally employed in fabricating vessels for various domestic purposes.

It is also employed in the composition for Printers Types.

ZINC, is in colour between the Silvery White, and Lead Grey. L.3. H.6. Sp. Gr. 6,862. It melts as soon as ignited, when it inflames and sublimes in white flocks, which are called *Philosophical Wool*, *Pompholix*, or *Nihil Album*, and is a true OXIDE OF ZINC. When laminated into thin leaves, it takes fire by the flame of a taper, burning with a flame of a blue colour, mixed with green. *M. De Lassone*, considers it as a kind of metallic phosphorus.

If *Water* be poured on it when it begins to be ignited, the fluid is decomposed, and much hydrogen gas is

is disengaged, but mixed with carbon, derived from the Zinc.

Sulphuric Acid dissolves it in the cold, and produces much hydrogen gas; a black powder, which is Plumbago, is separated, and a salt is formed in tetrahedral crystals, terminated by four sided pyramids. This is the SULPHATE OF ZINC, *Vitriol of Zinc*, *White Vitriol*, or *White Copperas*.—This salt is not much altered by exposure to air, when pure; but its Acid escapes, at a degree of heat, less than is required by the sulphate of Iron.

The *Nitric Acid* attacks Zinc with vehemence, even when diluted with water; snd, by slow evaporation, yields crystals in compressed and striated tetrahedral prisms, terminated by four sided pyramids, being the NITRATE OF ZINC, which is deliquescent. It emits red vapours when heated; becoming soft, and preserving that softness for some time.

The *Muriatic Acid* attacks Zinc, with effervescence: hydrogen gas is produced, and an *irreducible Oxide of Zinc* is deposited in black flocks. The solution thickens by evaporation, without crystallizing, a concentrated Acid escapes, and the MURIATE OF ZINC will itself sublime by distillation.

The *pure Alkalis* boiled on Zinc obtain a yellow colour, and dissolve part of the metal. It detonates strongly if mixed with *Nitrate of Pot-ash*, and thrown into an ignited crucible. The *Muriate of Ammoniac* is decomposed by it, simply by trituration,

tion. Fused with *Antimony* it forms a hard and brittle alloy; with *Tin* and *Copper* it forms BRONZE; and with *Copper* alone, it forms BRASS.

ANTIMONY is of a greyish white colour. L. 3. H. 6,5. Sp. Gr. 6,860. It is a moderately brilliant semi-metal, difficult of fusion; but when melted, emitting a white fume, called *Argentine snow*, or *Flowers of Antimony*, being a SUBLIMED OXIDE OF ANTIMONY, in brilliant prismatic acitules. The metal whilst cooling slowly, crystallizes, and generally assumes a stellular form, on its surface. It is very slightly changed by exposure to air. When combined with *Sulphur* in the earth, it forms a SULPHURET OF ANTIMONY, being an *Ore of Antimony*, commonly called *Crude Antimony*, or improperly, Antimony.

This sulphure of Antimony, reduced to powder and exposed in a shallow vessel to a slow heat, gradually loses its sulphur; and the oxygen of the atmosphere uniting with the antimony, converts it to a GREY OXIDE. This being urged by a more violent heat, becomes a reddish, and partly a transparent GLASS OF ANTIMONY, which when corrected by being blended with wax, forms the CERATED GLASS OF ANTIMONY.

Antimony is separated from the sulphuret, or crude

crude Antimony, by detonating three parts of crude tartar, two of crude Antimony, and one of nitrate of Pot-ash. After fusion, the Antimony will be found at the bottom of the crucible covered with a brown *Scoria*.—It combines again readily with sulphur, forming by fusion, a mass, not unlike to the ore of Antimony, just mentioned, but with only half its weight of sulphur.

Tin, *Copper*, *Silver*, or *Iron*, being fused with sulphure of Antimony, unites with the sulphur, and separates the Antimony, which, according to the metal employed, was called *Regulus of Mars*, *Venus*, &c.

The *Sulphuric Acid* by slow ebullition on Antimony, is partly decomposed. Sulphureous gas is first separated, and sulphur itself sublimes, towards the end; an *Oxide* is formed as well as a small quantity of SULPHATE OF ANTIMONY, which is very deliquescent, and easily decomposed.

It decomposes the *Nitric Acid* with great facility, part of the Antimony is oxidated, forming the *Bezoar Mineral*, and a portion is dissolved, forming a NITRATE OF ANTIMONY, decomposable by heat, and very deliquescent.

The *Muriatic Acid* acts upon Antimony only by a long digestion, forming a MURIATE OF ANTIMONY, crystallizable in the form of small needles, but very deliquescent, and is also both fusible and volatile. Two parts of the corrosive muriate of Mercury and one of Antimony distilled together, a slight degree

degree of heat drives over a butyraceous matter, the SUBLIMED MURIATE OF ANTIMONY, or *Butter of Antimony*. The Acid, as in the corrosive muriate of Mercury, being in an oxygenated state. The sublimed muriate of Antimony becomes fluid by a very gentle heat, and is thus easily poured from one vessel to another. It sometime crystallizes in hexahedral prisms with dihedral summits, two sides of the prisms being inclined —Diluted with water, a white powder, an oxide of Antimony falls, called *Powder of Algaroth*, or *Mercurius Vitæ*.

The *Oxy-muriatic Acid* acts on it with violence; the OXYGENATED MURIATE being very deliquescent. *Wine* and the *Acetous Acid* dissolve it.

The *Acid of Tartar* forms with it the well-known salt, the ANTIMONIATED TARTRITE OF POT-ASH, *Emetic Tartar*, or *Stibiated Tartar*. *Mr. Chaptal* remarks that this preparation often varies in its strength, and wishing to establish an uniform process for its formation, proposes transparent glass of Antimony to be boiled in water, with an equal weight of acidulous tartrite of Pot-ash, until the salt is saturated by filtration and slow evaporation crystals are obtained, in tri-hedral pyramids of a sufficiently uniform degree of emeticity. The *Gastric fluid* dissolves this semi-metal, as is proved by the famous perpetual pills. *Simple Water* had also some action upon it, since it becomes purgative by remaining in contact with it. Mixed with the *Nitrate of Pot-ash*, the

salt

salt is completely decomposed. Equal parts being thrown into an ignited crucible, the salt detonates, its Acid is decomposed, and the crucible is found to contain the Alkali, which served as the base of the nitrate; and the Antimony reduced to a *white Oxide*, called *Diaphoretic Antimony*.—By using the sulphure of Antimony, with three parts of the nitrate, the residue in the crucible, after detonation, is oxide of Antimony, fixed Alkali, a portion of nitrate not decomposed, and a small quantity of sulphate of Potash. This compound is called the *Solvent of Rotrou*. Water deprives it of the Salts, leaving only the oxide of Antimony, which is called *Washed Diaphoretic Antimony*. If to the water holding these Salts in solution, a small quantity of Acid be added, the small portion of oxide held in solution by the Alkali, is let fall. This precipitate has been called *Ceruse of Antimony*, or the *Materia Perlata of Kerkringius*. Equal parts of the nitrate and of the sulphure of Antimony, detonated in an ignited crucible, form the SULPHURATED OXIDE OF ANTIMONY, or *Liver of Antimony*, which when washed, produces the *Crocus Metallorum*, or *Saffron of Metals*.

Pure Alkalis in solution being boiled for half an hour, with sulphure of Antimony in the proportion of ten pounds of solution to two of the sulphure, a beautiful RED ALKALINE OXIDE OF ANTIMONY, called *Kermes Mineral*, subsides by mere cooling. The remaining liquor still retaining more Kermes, which may be precipitated by an Acid: this is paler than

the former, and is known by the name of *Golden Sulphur of Antimony*.

Lime, or *Lime-water*, digested for some days, even without heat, on powdered Antimony, yields a beautiful red oxide. Ammoniac being distilled from Antimony, a pulverulent *Sublimate of a purple colour* is obtained, being a *Sulphure of Antimony*, with base of volatile Alkali.

BISMUTH, or *Tin-Glass*, is white, darkened by a shade of red, or yellowish red. It yields a little under the hammer, but is so brittle, that it may be thus reduced to powder. L. 3,4. Sp. Gr. 9,8227, and next to Tin the most fusible of all metallic bodies. It tarnishes in the air, and acquires a powdery surface.

When exposed to a strong heat it burns with a blue flame, and sublimes in a yellowish smoke, which forms, when condensed, an OXIDE OF BISMUTH, or the *Flowers of Bismuth*. These flowers may be vitrified into a brownish glass.

It readily combines with *Sulphur* by fusion, and forms a blueish grey artificial Ore, or SULPHURET OF BISMUTH, which crystallizes in beautiful tetrahedral acicules.

Sulphuric Acid being boiled on it, the Bismuth is partly dissolved, forming the SULPHATE OF BISMUTH,

MUTH, which is very deliquescent. The *Nitric Acid* is speedily decomposed by Bismuth ; nitrous gas is separated, whilst the oxygen combines with the semi-metal, and a portion is dissolved which yields rhomboidal, tetrahedral prisms, terminating in tetrahedral pyramids with unequal faces, being the NITRATE OF BISMUTH, which effloresces in the air. The *Muriatic Acid* does not act on it, but by the aid of heat and concentration ; the MURIATE OF BISMUTH is deliquescent and difficult of crystallization. The *Acetous Acid* does not take up the oxides of Bismuth, as it does those of Lead. Water precipitates this semi-metal from all its solutions ; the precipitate, when well washed, being employed as a white paint for the complexion, and is known by the name of *Magistery of Bismuth* : but sulphurous hepatic vapours, and even the animal transpiration, blacken it, and reduce it to a metallic state. It is also employed in pomatums to blacken the hair.—Its various solutions form pellucid sympathetic inks, which are curious from the facility with which they become black.

It renders *Gold* brittle, and communicates to it its own colour, but it does not render *Silver* so brittle as does *Gold*. It diminishes the red colour of *Copper* ; with *Lead*, it forms an alloy of a dark grey colour ; with *Tin* it gives a greater degree of brilliancy and hardness ; with *Iron* it is not united, but by a violent heat ; and with *Mercury*, it amalgamates and forms a fluid alloy.

COBALT is white, inclining to a blueish grey; and if tarnished, to red, L.3. H.8. Sp. Gr. 7,645. When very pure it is malleable, in some degree, in a red heat. Even when purest it is magnetic, and when not magnetic, it is contaminated with Arsenic. It is not volatile in close vessels, and when pure, is as difficultly fusible as Iron, but is rendered more fusible, and of a brown colour, by the addition of Arsenic. It calcines with more difficulty, as it is more pure; its oxide being of so deep a blue, as to appear black.

Whilst in its metallic state, it tinges no earthy substance; but in contact with fluxes it readily calcines, hence treated with *Borax*, *Soda*, *Pot-ash*, *Microcosmic Salt*, in a strong heat it tinges them blue —In fusion, it will not mix with *Bismuth*, *Lead*, or *Silver*; but with *Bismuth* it unites by the mediation of *Nickel*. With *Arsenic* it burns with a blueish or white flame.

With concentrated *Sulphuric Acid*, it unites and yields reddish crystals, the SULPHATE OF COBALT.

It unites with the *Nitric Acid* readily, and with effervescence; the solution is reddish, and yields hexahedral crystals, the NITRATE OF COBALT: if *Arsenic* predominates, the solution is first whitish, and then becomes red. The *Muriatic Acid* dissolves it with difficulty, requiring heat: the solution, which

is

is pale red, holding in solution the MURIATE OF COBALT.

If contaminated with much *Nickel*, the above solutions are greenish. Its oxides yield to the *Acetous Acid* and to *Ammoniac*; the solutions with the former, are red and purple; with the latter, blue when hot.—With the *Nitro-Muriatic Acid*, the solution is red; if contaminated with *Iron*, brown. This solution, or that in *Nitric Acid*, if common Salt be added, affords what is called *Sympathetic Ink*, for though letters traced by it are invisible while cold, yet when heated they appear green, if the Cobalt retains much Iron, but blue, if free from Iron.

Its solutions are not precipitable by Zinc.

It was employed to give a blue colour to glass, long before it was supposed to contain a semi-metal.

The ores of Cobalt are torrefied in Saxony in furnaces, the arsenical vapours attaching themselves to the sides, yield the Arsenic of Commerce. When the oxide of Cobalt is cleared of Arsenic, it is known by the name of ZAFFER. The Zaffer of Commerce is mixed with three fourths of Sand. This oxide fused with three parts of Sand and one of Pot-ash, forms a blue glass, which when pounded, sifted, &c. forms SMALT.—Smalts are used in the preparation of Cloths, Laces, Linens, Muslins, Threads, &c. When it is separated by water from the grosser particles, it is called AZURE. The Azures mixed with Starch form the BLUES used by laundresses. Besides being used for colouring glass,

it is also used for blue paintings on porcelain. The most simple way of obtaining Cobalt in its metallic state, is to reduce it from Smalt, by fusing one part of Smalt with six of Soda.

NICKEL is a metallic substance of a greyish white, when pure; but shaded with red or yellow, when impure. L.3 H.8. Sp. Gr. 7 to 9. It is difficultly purified. When purest it is magnetic, and hence has been deemed to contain Iron, even when it exhibits no other sign of its containing any: but Mr. Kirwan thinks without sufficient reason. It is malleable in a considerable degree, and calcines slowly in a strong heat: if pure, the oxide is brown, if impure, greenish; rising in tuberous vegetations, proceeding from Iron or Arsenic.—When pure, it requires as strong a heat as cast Iron, the impure melts more easily. Fused with sulphur, it forms a hard low mineral; and with the sulphure of Potash, a compound resembling the yellow copper-Ores. It does not amalgamate with Mercury.

The *Sulphuric Acid* distilled on it, leaves a greyish residue, which when dissolved in water, communicates a green colour. This is the SULPHATE OF NICKEL, which effloresces in the air. The *nitric Acid*, with heat dissolves it, and yields the NITRATE OF NICKEL, in crystals of a beautiful green, in rhomboidal cubes. The *Muriatic* dissolves it also, with heat,

heat, but more slowly; the MURIATE OF NICKEL being in long rhomboidal octahedrons, of the most beautiful emerald green.—The *Acetous Acid* acts only on its calces. The *fixed Alkalis* precipitate the Nickel in the foregoing solutions, greenish white. *Ammoniac* also precipitates them, but in excess redissolves them, the solution being blue; even metallic Nickel yields to Ammoniac. It is not precipitable by Zinc, though in some measure by Iron.

MANGANESE is a greyish white, but soon darkens by exposure to the air; its surfaces oxidating, until at last it becomes black, and frequently friable between the fingers. L.3.2. Fracture, uneven; In no degree malleable. H.8. difficultly frangible, Sp. Gr. 7,000. *Hielm.*

It is magnetic when pulverised, rarely so in lumps. By heat it is soon converted into a black oxide, and, if strongly urged, affords a glass of a yellowish brown, depositing the Iron in a regular form. This metal is more fusible than Iron, and unites by fusion, with all the metals, except Mercury. *Copper* alloyed with Manganese, in a certain proportion, is still very malleable. The oxide of Manganese affords a prodigious quantity of oxygenous gas; and with charcoal, the carbonic Acid.—Kept in fusion, with *Phosphate of Soda*, upon charcoal, a transparent glass

is

formed, which curiously changes from the colour of a ruby, to a colourless state, and again becomes coloured, according to the quantity of phosphate, and to its exposure to the interior or exterior part of the flame.

The *Sulphuric Acid* attacks Manganese, and produces hydrogenous gas; with the oxide it produces an astonishing quantity of oxygenous gas. The SULPHATE OF MANGANESE forms in parallelopids of a bitter taste. The *Nitric Acid* dissolves Manganese, with effervescence: The oxides are also soluble in the nitric Acid.—The *Muriatic Acid* also dissolves Manganese, but neither the NITRATE nor the MURIATE OF MANGANESE crystallizes.——With the *fluoric Acid*, a salt of sparing solubility is formed, so likewise with the *Phosphoric Acid*. The *Acetous Acid* acts but weakly on it: the *oxalic* dissolves the Manganese, and the black oxide of Manganese also. The *Acidulous tartrite of Pot-ash* dissolves the black oxide, even in the cold; and, added to any solution of Manganese, precipitates a true TARTRITE OF MANGANESE. The *Carbonic Acid* attacks both Manganese and its black oxide. *Muriate of Ammoniac* being distilled with the oxide, the oxygen of the latter unites with the hydrogenous gas of the Alkali, and forms water, the nitrogen gas escaping. Manganese itself does not appear to combine with *Sulphur*; but eight parts of oxide, with three parts of sulphur, form a mass of a greenish yellow colour, which Acids attack with effervescence, and occasion an hepatic

hepatic smell. Manganese is precipitated from its solutions by the *Alkalis*, in the form of a gelatinous matter, which becomes black as it absorbs oxygen. From the rapidity with which this change takes place, it is well calculated to form an eudiometer, by being diffused on the internal surface of proper vessels, and marking, by the ascension of water in a graduated tube, the absorption of oxygen.

If one part of the native oxide of Manganese, and three parts of nitrate of Pot-ash, be melted in a crucible, till no more oxygen gas is disengaged, a greenish friable powder is obtained, termed *Chamælion Mineralis*, an ALKALINE OXIDE OF MANGANESE, which forms a greenish solution, soon changing to a violet, and lastly to a red.

Scheele has proved, that the ashes of vegetables contain Manganese; and that it is to this mineral, that the colour of calcined Pot-ash is owing. Of all metallic substances it is, after Iron, the most generally, though minutely diffused through the earth.

URANITE, or the metal of Uranochre, discovered by Klaproth, in 1790, is of a dark steel or iron grey; internally browner. L. 2. metallic. H. 6 to 7. Sp. Gr. 6,444.—soluble in nitrous acid. It does not appear that other acids have been tried.

Infusible

Infusible before the blow-pipe, but with microcosmic salt, or concrete phosphoric Acid it becomes a grass green glass; and with soda or borax only a grey opake scoriacious bead. Its oxide is yellow, and is easily soluble in Acids. With dilute *sulphuric* and the concentrated *acetous* it yields yellow crystals; with the *phosphoric*, an amorphous, white, difficultly soluble mass; and with the *nitrous-Acid* and *nitro-muriatic*, greenish yellow crystals. The precipitate thrown down from these two last mentioned solutions by sulphurated ammoniac, is of a brownish yellow; by *tincture of galls*, the superfluous Acid being saturated, of a chocolate brown; by *Prussian Alkali*, a brownish and red granular precipitate, diffused through the whole liquor: that of Copper, by this alkali, being flaky; and that of molybdena, not so brown. By *carbonated fixed Alkali*, whitish yellow; much of which is redissolved by the carbonic acid gas set loose. By *pure Ammoniac*, lemon yellow. By *carbonated Ammoniac*, dark yellow. But these solutions are precipitable neither by *Iron* or *Zinc*. This oxide is insoluble in alkalis, either in the moist or dry way; which fully distinguishes it from tungstenic oxide, which it resembles in colour.

SYLVANITE or TELLURITE. *Klaproth*, although he first appears to have clearly ascertained the

the existence of this metal, modestly gives the honour of the discovery of it to *Muller*, and even to *Bergman*. Mr. *Kirwan* first called it Sylvanite, but Mr. *Klaproth* denominated it Tellurite.

It is one of the most volatile and fusible of the metals, except Quicksilver, and is of a dark grey colour, inclining to red, and of considerable metallic splendor. It is semi-ductile and semi-malleable, Sp. Gr. 6,115. It readily unites to *Quicksilver* and *Sulphur*. It is soluble in *sulphuric* and *nitro-muriatic Acid*, and is precipitated from its solutions, in a metallic state, by *Iron*, *Zinc*, *Tin*, and even by by *Muriate of Tin*; also by *saline Sulphurets*, yielding SULPHURIZED OXIDE OF SYLVANITE.

The order of affinities of the OXIDE are not well determined.

Dr. Pearson's Nomenclature, 1799.

TITANITE, was first discovered to be a metallic substance by Klaproth, it having been before that considered as a red shorl. The same indefatigable chemist has discovered its existence in MENACHANITE, a substance first noticed by Mr. M'Gregor, in the valley of *Menachan* in Cornwall, in small black grains resembling gunpowder. Mr. *Kirwan* pointed out the resemblance between this substance and Titanite.

If,

If, Dr. Pearson observes, the metal of Menachanite be the same as the Titanite, it yields a deep green precipitate, with *Prussic Acid*, and an orange red coloured one with *Gallic Acid*. It scarce dissolves in *Oxy-muriatic* or *Nitro-muriatic* Acids. The Titanite in *muriatic aqueous solution*, parts with oxygen to *Zinc*, becoming of an indigo-blue colour, and parts with still more oxygen to *Tin*, becoming of a bluish red colour. It scarcely unites with *fixed Alkalis*, even in fusion. *Nomenclature*, 1799.

On the authority of *Lampadius*, the order of attraction is, gallic, phosphoric, arsenic, oxalic, sulphuric, muriatic, nitric, and acetous Acids.

Annales de Chimie, XXVI.

CHROME is a metallic substance, of a whitish grey, shining, and very brittle; obtained by Vauquelin from the mineral, called *Siberian Red Lead*.

By various analyses, he obtained from the same mineral, an Acid, which he termed the CHROMIC ACID, which crystalizes in small long prisms of a ruby red colour; forming with *Mercury*, a compound of a cinnabar red colour; with *Silver*, a carmine red compound; with *Lead*, an orange yellow mineral; and with *Iron* or *Tin*, the solution of the Acid becomes green. It yields part of its oxygen to muriate

riatic Acid, by which it oxygenates it, passing itself to a green oxide. *Journal des Minis*, xxxiv. 1798.

The OXIDE OF CHROME is of a beautiful green. The ACID is of a ruby-red, and contains about two-thirds of its weight of oxygen, and on parting with a certain portion of oxygen, even to Light, the OXIDE OF CHROME is formed, which is of a beautiful green. *Annales de Chimie.* xxv.

Tassaert has not only found the Chromic Acid united to Lead, but also to Iron.

Annales de Chimie. xxx.

ARSENIC.—Its natural colour is white with, a strong shade of blue, but it quickly tarnishes by exposure to the air, becoming pale yellow, and at last greyish black. L.3. H.7. Sp. Gr. 8,310. It is not soluble in water. It evaporates before fusion, in the form of a white smoke, with an alliaceous smell. On burning coals, it gives a low bluish white flame, and white smoke; in close vessels, it sublimes without alteration, and crystalizes in trihedral pyramids, or octahedrons, of a brilliance resembling Steel.

The substance which in general is called Arsenic, is a metallic oxide of a glittering whiteness, some-

 times

times of a vitreous appearance; exciting an acrid taste on the tongue, and subliming with the same smell and smoke as the Arsenic itself. It may be reduced to the metallic state by treating it with Oils, Soaps, or Charcoals, in close vessels.

It is often combined with metals in various ores, and is disengaged from them by calcination. It unites, by fusion, with most of the metals; those which were ductile, becoming thereby brittle; those which were difficult of fusion, flowing more easily; and those which were very fusible, becoming refractory. The yellow or red metals being also rendered white.

The oxide is less volatile than the metal itself. If sublimed by a strong fire in closed vessels, it becomes transparent like glass.—The oxide requires for its solution eighty times its weight of water, at 12° and fifteen at boiling heat: and of alcohol seventy or eighty at boiling heat.—Like the other metallic oxides, it is convertible into a metallic Glass by a strong heat, and forms an opaque insoluble substance possessing metallic brilliancy; but unlike them, it is soluble in water, unites with metals, is volatile, and emits a strong odour.—By its union with sulphur, either ORPIMENT, or REALGAR is formed, the latter being the result of employing a more violent heat:—both these substances being decomposed by Lime and the Alkalis, which disengage the oxide.

Pure Pot-ash boiled on the oxide of Arsenic, becomes

comes brown, gradually thickens, and at last forms a hard, brittle, but deliquescent mass; the ACIDULOUS ARSENIATE of POT-ASH.

Soda exhibits phenomena nearly similar with this oxide, forming the ARSENIATE OF SODA.

Ammoniac dissolves the oxide by heat, and yields crystals by spontaneous evaporation, which are the ARSENIATE OF AMMONIAC.

The vitrification of the *Earths* is accelerated by the oxide of Arsenic; but the glasses, thus formed, soon tarnish.

The *Muriatic Acid* attacks Arsenic very feebly; but equal parts of Orpiment and *Corrosive Muriate of Mercury*, being distilled by a gentle heat, a blackish corrosive liquor distils, which is the SUBLIMED MURIATE OF ARSENIC, or *Butter of Arsenic*.

The *Nitric Acid*, and the *Oxygenated Muriatic Acid* distilled from the oxide of Arsenic, are decomposed; from the former, nitrous gas passes over abundantly, and from the latter, ordinary muriatic Acid; their superabundant oxygen being seized by the arsenical oxide, which is thereby changed to the ACID OF ARSENIC. This Acid is also obtained from the residue of the distillation of equal parts of nitrate of Pot-ash and oxide of Arsenic, which yields a red, and almost incoercible nitric Acid.

This residue is capable of being crystallized in tetrahedral prisms terminated by four sided pyramids, this arseniate of Pot-ash, the neutral arsenical

Salt of *Macquer* being mixed with half its quantity of sulphuric Acid, and urged by a strong fire, a white mass is left in the retort, which attracts humidity, and is the *pure Arsenical Acid*. The nitrate of Ammoniac with the oxide of Arsenic, also, being distilled, the Arseniate of Ammoniac remains, from which the Alkali being driven by a fire long kept up, the residue is a vitreous, deliquescent mass, the Acid of Arsenic.

The *Sulphuric Acid* boiled on the oxide, dissolves it, but the oxide is precipitated on cooling. If the whole of the Acid be dissipated by a strong heat, the arsenical Acid remains.

THE ACID OF ARSENIC may possess the concrete form, but deliquesces and resolves into a fluid. It is fixed in the fire, but heated in contact with a coaly substance, it is decomposed, the oxygen exhaling in fumes. It is also reduced by passing hydrogen gas through it. *Pelletier*.

At 12° it requires only 2-3rd's of its weight of water to dissolve it: and when thus dissolved, it may be concentrated and again brought to the state of a transparent glass. In the state of concentration it acts strongly on the crucible, dissolving the Alumine. Saturated with Ammoniac, and duly evaporated, it forms rhomboidal crystals, which may by heat be resolved into a vitreous mass. *Barytes* and *Magnesia* appear to have a stronger affinity with this Acid than the Alkalis. *Lime* also decomposes the alkaline arseniates.

Arsenic,

Arsenic, besides being used in mixture with metals, is employed by Dyers, and is also used as a flux in Glass-houses. It is also a component part of some glazes.

MOLYBDENITE.—This semi-metal was obtained from the sulphurated Ore, called *Molybdena*, by *M. Hielm.* Sp. Gr. 6,1. It is nearly infusible in our furnaces, calcining in a red heat, and in a reguline state gives no colour to Borax.

The *Nitric Acid* attacks it with effervescence, and converts it into an oxide, endued with Acid properties ceasing to act as soon as the super-saturation with oxygen is effected.

Hatchett. Phil. Trans. V. 86.

The *Muriatic Acid* has no effect on it; nor even the *Nitro-muriatic*, unless it contains four-fifths of nitric Acid.

The *Sulphuric*, concentrated and boiling, acquires from it, first a green, then a blue colour; but by long boiling it loses all colour.

The MOLYBDENIC ACID may be obtained by the OXIDE OF MOLYBDENITE being oxygenated as perfectly as possible. It may be procured by the desulphuration, and oxygenation of the sulphurated ore of this semi-metal, namely *Molybdena*; and this may be performed either by combustion, detonation

by nitre, or by solution in the nitrous Acid. The most perfect Acid is obtained by the last method. To oxygenate it perfectly, twenty times its weight of nitrous Acid must be distilled over it in five successive portions, being then edulcorated, and dried it is as white as chalk. However it still retains some sulphuric Acid, from which it may be in a great measure purified by repeated fusion in close vessels, or perhaps by adding to its solution, the solution of muriated Barytes.

The Molybdenic Acid thus purified, is of the Sp. Gr. 3,750,—soluble in 570 times its weight of water at 60°. Fahrenheit; in *Sulphuric Acid*, which it renders blue when cold, though colourless when heated; in the *muriatic*, which it renders blue when heated and concentrated; but it is insoluble in the nitric Acid.

The solution of the Molybdenic Acid, forms MOLYBDATES, by acting on the imperfect metals, as *Tin*, *Zinc*, &c. rendering them blue, particularly when heated, as they strip it of its oxygen.—It precipitates the nitrated solutions of Silver, Mercury, and Lead, the solutions of muriated Lead, and of Barytes in the nitrous or muriatic Acids, but not those of the other earths. With the *Earths* it forms difficultly soluble molybdates; and with the Alkalis it unites and effervesces, but is not discoloured.

Molybdena, when not in a metallic state, appears to suffer four degrees of oxygenation, 1st. black oxide,

oxide, 2d, blue oxyde, 3d, green, which, as it is intermediate between an oxide and an acid, may be called according to the distinction made by the new nomenclature, Molybdous Acid, the last or 4th degree is the yellow Acid, or that which is super-saturated with oxygen, heated in close vessels, it melts; in open, it sublimes; before the blow pipe, on charcoal, it is speedily absorbed. With microcosmic Salt it becomes green, with borax grey, and slowly also green.

Mr. Hatchett observes, whenever a solution of of the molybdic Acid becomes blue, or tending towards that colour, it is a sign that the molybdic Acid has suffered a diminution of oxygen.

Hatchett. Phil. Trans. V. 86.

TUNGSENITE, is said to have been obtained in a metallic form from the mineral called *Tungsten*, or *ponderous Earth*, and from another mineral called *Wolfram*. It is supposed to be capable of existing in three states.

I. That of a REGULUS, externally brown, internally steel grey. L. 2. Metallic in very minute globules, being more difficulty reducible to a metallic state than Manganese or Uranite. Brittle, Sp. Gr. 17,600. It is insoluble in the mineral Acids, but convertible by the nitric, and nitro-muriatic

into

into a yellow oxide, and likewise by heat, increasing 24 per cent. in weight.

This metal was said to be obtained by Messrs. Elhuyarts, but their experiments have not been repeated with success.

II. That of a YELLOW OXIDE, Sp. Gr. 6.12. insipid, and insoluble, but diffusible in water, not being deposited for some months. Ammoniac being added, it whitens it, which distinguishes it from the yellow oxide of uranite.—Exposed to the external flame of the blow pipe, it continues yellow; but by the internal, it swells and darkens, but does not melt. This is the reverse of what takes place with manganese, which is coloured by the external, and becomes colourless by the internal flame. The privation of oxygen blackens this substance, and whitens manganese.—Microcosmic salt being added, it loses all colour in the external flame, but in the internal, it gives a blue glass, but the addition of an alkali again renders this blue glass colourless.—With borax it gives a brownish yellow glass—heated on a burning coal, or in a crucible, it becomes a slate blue colour, but does not dissolve.—In pure alkalis, this oxide is completely soluble both in the dry and moist way, and the solution always retains an excess of alkali. If to this nitric acid be dropped, a white precipitate will fall, as long as an excess of alkali remains, the liquor becoming bitter. This white precipitate is soluble by agitating the liquor, and has the properties of an Acid. But if so much Acid is added

added, to destroy the access of alkali, the white precipitate loses its acid properties. The yellow calx is also soluble in ammoniac and retains an excess of it, affording acicular crystals, which are acid, turning litmus red. If these crystals be calcined, the excess of alkali is expelled, and the yellow oxide is produced in open vessels, and a blue, in a retort. Digested in the *Sulphuric Acid* they are converted into the blue, and in the *nitric* or *muriatic*, into the yellow oxide. If to the solution of this calx a few drops of *nitrous Acid* is added, a white precipitate, which is also acid, is produced. The yellow oxide blackens by exposure to the sun or moisture, or by calcination in close vessels, when it forms plumose crystals; it also unites to sulphur in the dry way, and forms a blueish black, brittle, crystallized mass.

III. The Acid of Tungsten always appears in the form of a white oxide as already described, though the white oxide is not always Acid. It is formed by the yellow calx with, 1st, an excess of ammoniac, and may be called the *fulminiginated Oxide*; 2d, by an excess of ammoniac, and the addition of an acid, and may be called the *Acido-fulminiginated Oxide*; 3dly, by an excess of tartarin and the addition of an Acid, which may be called the Acido-tartarinated calx.

These apparently Acid oxides do not seem to be of a fixed nature, endowed with constant invariable properties.—The yellow oxide seems to be the true Tunstenic Acid, though by super-oxygenation

many

many of its Acid properties are disguised. The superfluous oxygen is in a great measure destroyed by the ammoniac, this latter being decomposed, its inflammable matter passing into water. Its insolubility resembles that of oxygenated muriatic Acid, and of the Prussian Acid, and only differs in degree. Its union with alkalis, with lime and with metals, even the noble metals, plainly evinces its Acid nature, for as a simple calx it could not unite with them. *Kirwan.*

The substance known till now under the name of Acid of Tungsten ought no longer to be considered as such, but as an oxyd of Tungsten; it appearing from the Experiments of D'Elhuyarts, Vaucquelin and Heept, that the Acid properties which it appears to possess arise from the Acid employed in the precipitation being retained.

Medical and Physical Journal, May 1799.

C. Guyton observes, that Tungsten in the last degree of oxygenation has a decided advantage over all the other metallic oxides, in forming *Lakes* of great value to painters, which resist powerfully the greatest enemies to colours.

La Decade Philos. &c. 1798.

BITUMINOUS SUBSTANCES.

NAPHTHA is a white or yellowish white substance, fluid as water, feels greasy, has a penetrating smell, and

and burns with a light flame, leaving scarcely any residuum. It is insoluble in spirits of wine, passes over entirely in distillation, and is thickened, but not inflamed by nitrous Acid.

PETROL, or PETROLEUM, is a brown semi-transparent substance; being Naphtha, thickened, and altered in colour and other respects by the air.

MINERAL TAR is petrol farther altered by the air, having become of the colour and consistency of pitch.

ASPHALTUM, or MINERAL PITCH, is produced by a still farther exsication. There are three varieties described of this substance, depending chiefly on the degree of solidity they possess. 1. *Cohæsive* mineral Pitch. 2. *Semicompact*, MALTHA. 3. *Compact*, ASPHALT.

JET is a substance of a full black, harder, and less brittle than Asphalt; and according to *Weidenman*, is a species of coal; but in the opinion of *Fourcroy*, it is indurated Asphalt.

CANNELL-COAL appears to be next to Jet in gradation of the compound mineral bituminous substances.

MINERAL TALLOW is rarely met with, and imperfectly known. It much resembles tallow.

MINERAL CAOUTCHOUC is a substance much resembling in its elastic properties, the substance from which it takes its name.

Mr. Hatchett, observes that, we can only infer that animal substances have contributed to the formation

mation of bitumen from the vestiges, and exuvia of animals, which so commonly accompany bituminous substances; but no doubt can be entertained in respect to vegetables; for it appears that bitumen is formed from them by long maceration, and by other processes at present unknown to us.

The elementary principles of bitumen are, hydrogen, Carbon, sometimes azote, and probably some oxygen, which, by its action on the other principles, tends to form the concrete bitumens; and also produces that portion of Acid obtained by chemical operations. These same principles, hydrogen and carbon, constitute the vegetable oils and rosins; and the same with some azote, form the oils and grease of animals.

Organized bodies buried and subjected to the action of mineral bodies, under certain favourable circumstances, may form, *Mr. Hatchet* thinks, with some small change perhaps in the respective proportions of their principles, a new combination which we call Bitumen. *Mr. Hatchett, Nicholson's Journal.*

Pit-Coal, according to *Mons. Gensanne* and others, is an earth or stone, chiefly of the argillaceous genus, penetrated or impregnated with petrol or asphalt. It has also been supposed to have been formed by vegetables growing in the sea, and by vast forests which have been buried by subsequent revolutions. *M. Arduino* supposes it to be of marine formation, deriving its existence from the fat and unctuosity

inctuosity of the numerous tribes of animals that inhabit the ocean.

Mr. Kirwan objects to the above opinions. He supposes the carbonic substance and petrol, to have entered into the composition of various stones of which many mountains have been composed, having been derived from the primordial chaotic fluid. He also thinks that coal-mines, or strata of coal, as well as the mountains or hills in which they are found, owe their origin to the disintegration and decomposition of primeval mountains, which contained, most probably, a far larger proportion of carbon and petrol, than those of the same denomination now contain, since the disintegration took place at so early a period. *Geological Essays*, 1799.

Mr. Kirwan, by a series of those experiments by which he has enriched the science, has been enabled to give a synoptical view of the contents of Bitumen, and different sorts of Mineral Coal.

100 parts contain	Carbon.	Bitumen.	Ashes.	Sp. Gr.
Maltha	8	——	——	2,070
Asphalt	31	68	——	1,117
Kilkenny Coal	93,3	——	3,7	1,526
Compact Cannel	75,2	21,68 maltha	3,1	1,232
Slaty Cannel	47,62	32,52 maltha	2,0	1,426

	Carbon.	Bitumen.		Ashes.	Sp.Gr
Whitehaven	57	41,3	mixt	1,7	1,257
Wigan	61,73	36,7	mixt	1,57	1,268
Swansea	73,53	23,14	mixt	3,33	1,357
Leitrim	71,43	23,37	mixt	5,20	1,351
Newcastle	58	40	mixt	——	1,71

Elements of Mineralogy, 1799.

AMBER is a bitumen, generally of a yellow or brown colour. It is found either under the surface of the ground, among the clay, sand, and Iron bog ore, when it is called *Fossil Amber*, or is thrown on the shore by the waters of the sea, and is then called *Mineral Amber*. It is tasteless, but when rubbed it yields a faint odour, and manifests electric powers. It is not soluble in water, and but slightly in spirits of wine, except by the addition of Alkalis, when the solution is termed *Tincture of Amber*. It is soluble in expressed oils, and also in oil of Turpentine, when it forms the *Amber Varnish*.

By distillation it yields an Acid phlegm, a light, dark coloured oil, which from repeated distillations from water or clay, becomes limpid, and is then called *Rectified oil of Amber*, and a concrete Acid salt.

The SUCCINIC ACID may also be obtained pure and white, by distilling diluted *Nitric Acid* with half the quantity of Salt of Amber, the nitrous gas coming over, and leaving the Succinic Acid in beautiful white, three-sided columnar crystals, whose points are truncated. *Hermstaedt.*

SUCCINATES are formed by the union of the succinis Acid with the Alkalis and Earths.

By

By mixing ten or twelve grains of Soap, four ounces of Alcohol, and one dram of Oil of Amber, with a proper quantity of caustic solution of Ammoniac, a compound of a milky colour is formed, called EAU DE LUCE.

OF STONES.

HAVING already given a sketch of the distinctive characters of the several earths, and of most of their combinations with Acids, and as it is not intended to describe the external character of *Stones* here, it is only proposed to point out the several combinations by which they are produced.

LIME alone, has been already remarked, is infusible; but it may be melted by the addition of clay, silex, oxides of iron, fusible salt, borax, and fixed alkalis. It also may be combined with the Acids. Hence we see, whether the formation of Stones be referred chiefly to the action of fire, or of water. The sources of the numerous varieties of this genus are very considerable.

Calcareous earths are characterized by a dry, harsh and meagre feel, discoverable even in their mixtures with other earths, if they constitute nearly one half of the mass. They are never hard enough

to strike fire with steel, nor are those compounds, in which they constitute a third part.

Under this genus may be placed the vast varieties of LIME-STONE, MARBLES, CHALK, TUFAS, CALCAREOUS SPARS, with ALABASTER and SWINE STONE, resulting from the union of *Lime*, with the *Carbonic Acid*. Here also may be placed the BARYTO-CALCITES, formed by the union of *Lime* with *Barytes*; MURICALCITE, with *Magnesia*; the ARGILLO-CALCITES with *Clay*, and the various MARLS and MARLITES proceeding from the same combination. By its union with *Manganese* and *Iron* are formed the SIDERO-CALCITES; and with a notable proportion of iron, the FERRI-CALCITES; and when *supersaturated with carbonic Acid*, the DOLOMITE and ELASTIC MARBLE. With the *sulphuric Acid* it yields the various SELENITES or GYPSUMS; with the *fluoric Acid*, the FLUOR SPAR; with the *phosphoric Acid*, PHOSHORITE; and with the *Tungstenic Acid*, TUNGSTEN.

BARYTES, or BARYT, though more difficultly than Lime, is soluble in the nitric and muriatic Acids, and it is affected by the same fluxes as the former earth, but possesses very little fusibility in combination with any of the other earths, except Silex. Its combinations are generally marked by their great degree of gravity, if not concealed by their porous structure.

With *carbonic Acid*, this earth forms the BAROLITE,

LITE, and with *sulphuric Acid* the BAROSELENITE. It also constitutes the greatest portion of the LIVER-STONE.

MAGNESIA is infusible alone, and very difficultly fusible when in combination with other earths, but it readily unites with Acids. The Stones in which it makes about a fifth part, have a smooth and unctous feel, unless opposed by the opposite characters of Lime: they have also frequently a greenish cast, are inclined to a striated or slaty structure, and to a lustre of the silky kind.

Magnesia mixed with *Silex* forms the SILICI-MURITE; with *Lime* and some *Iron*, CALCI-MURITE; with Clay and Iron, ARGILLO-MURITE, and with a farther addition of Silex and Lime, CHLORITE; by its combination with *Silex* and *Alumine*, are formed the TALCS, and by the addition of *Oxide of Iron*, and *Carbonic Acid*, the various STEATITES. The LAPIS OLLARIS contains a small portion also of the *fluoric Acid*. The SERPENTINES appear to result from its union with *Silex* and *Iron*, and by various intermixtures of CARBONATE OF LIME, are formed the ASBESTUS, AMIANTHUS, and the SUBER-MONTANUM, or CORIUM-MONTANUM. By somewhat similar combinations are produced also AMIANTHINITE, ASBESTINITE, ASBESTOID, and the SHORLACEOUS, and GLASSY ACTINOLYTE and JADE; in some of which is also contained the *fluoric Acid*. By

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its union with the *Boracic Acid*, *Alumine*, and *Iron*, is formed the stone called BORACITE.

ALUMINE OR ARGILL is fusible by the same saline fluxes like the other earths, and combines also with the Acids.

The smooth, soft, and unctuous feel of clay is discoverable in its mixtures with Silex, when it exists in a tenth part; but, with Lime, not unless it exceeds the Lime in quantity. Mixed with Magnesia, and not exceeding a fifth part, it gives a disposition to a slaty or lamellar structure.

From its admixture with *Siliceous Sand*, are formed the various CLAYS, FULLERS-EARTHS, LITHOMARGA, BOLES, MARLS, and COLORIFIC-EARTHS, which are coloured by various metallic, vegetable, or bituminous particles. From its union with *Silex* and *Iron*, proceeds the TRIPOLI; from its union with phosphoric Acid, PHOSPHOLITE; with *Silex Iron*, and *Manganese*, is formed LEPIDOLITE; and with the addition of *Magnesia*, SAPPARE; and by combinations, in some respects similar, MICA, MICARELLE, and with the addition of *Lime* HORNBLENDE, SCHILLER SPAR, WACKEN, MULLEN-STONE, KRAG-STONE, TRAP, TOADSTONE, BASALT, CALP, ARGILLITE, SLATES, and NOVACULITE.

SILEX is taken up by a solution of caustic fixed Alkali, nearly in the proportion of 1-6th of the Alkali. It appears to be soluble, when precipitated from its solution in fixed Alkalis, in 1000 parts of water; and

and its solution in fixed Alkalis, is capable even of supersaturation with an Acid, without precipitation; but in general it combines only with the *Fluoric Acid*.

Professor *Siegling*, having left a bottle of the liquor of Flints, prepared in the usual way, undisturbed for eight years, he found groups of tetrahedral pyramidal crystals, (artificial Rock Crystal) perfectly transparent, and so hard, as to give fire with Steel. *Journal de Pharmacie.*

When most pure, it is termed ROCK CRYSTAL, and QUARTZ, and from its mixtures with various proportions of *Iron*, *Lime* and *Alumine*, result the AMETHYST, TOPAZ, SAPPHIRE, HYACINTH, GARNET, CHRYSOBERYL, and OLIVIN. From its union with *Shorlaceous Actinolyte*, proceeds the PRASIUM; and with *Alumine* and *Iron*, OBSIDIAN; and *Manganese* being added to these, the result is SHORL. With *Alumine*, *Lime* and *Iron*, it forms the TOURMALIN and the PREHNITE; and with the addition of *Manganese*, THUMERSTONE. Combined with *Alumine*, *Lime* and *Water*, it forms the ZEOLITES; and with *Barytes* in the place of *Lime*, the STAUROLITE; with *Alumine*, *Oxide of Iron*, *Sulphate and Carbonate of Lime*, LAPIS LAZULI; with *Nickel*, *Iron*, *Alumine*, and *Lime*, CHRYSOPRASE; with *Alumine* and *Lime*, VESUVIAN, and with *Alumine* only, SHORLITE. If this last combination also holds *Oxide of Iron* and *Manganese*, RUBELLITE is the result; but if *Iron* only is added,

OPALS,

OPALS, SEMI-OPALS, and PITCH STONE. From the addition of *Lime* to the combination just mentioned, proceeds HYALITE. From the various intermixtures of *Alumine*, and a small portion of *Iron*, also proceed CALCEDONY, CORNELIAN, CAT'S-EYE, and ONYX; and by the farther addition of a small portion of *Lime*, FLINT, HORN-STONE, JASPER, EGYPTIAN PEBBLE, PORCELLANITE, HELIOTROPIUM, WOODSTONE, and ELASTIC QUARTZ are formed.

From the more compound mixtures of this species of earth with *Alumine*, *Magnesia*, *Lime*, and *Iron*, are formed the FELSPARS, and MOON-STONE, and with a small portion of *Copper*, the LABRADORE STONE. Nearly allied to these are PETRILITE, FELSITE, RED-STONE, and SILICEOUS SPAR. AGATES are composed of binary, ternary, or more numerous combinations of calcedony, jasper, quartz, hornstone, &c.

STRONTIAN, like Barytes, attracts first *Sulphuric*, and next *Oxalic Acid*, Lime and Magnesia having the strongest attraction for the oxalic.

It has only been found in a state of CARBONATE, in a lead Mine in Argyleshire, and near Boyra in Transylvania; and in a state of *Sulphate* in Freyberg, Syria, Hungary, and near Bristol.

JARGONIA. The only Stone of this genus, is the Stone called ZIRCON, or JARGON of Ceylon.

GLUCINE, the newly discovered earth of Vauquelin, is found to exist in the *Emerald of Peru*, in combination with *Alumine*, *Siliceous Earth*, *Lime*, and

and *Oxide of Chrome*. The BERYL, or AIGUE MARINE, also contains this earth with *Silex*, *Alumine*, *Lime*, and *oxide of Iron*.

Annales de Chimie. xxvi.

The RUBY appears, by the analysis of Vauquelin, to be a saline substance, composed of two bases, *Alumine*, *Magnesia*, and the *Chromic Acid*. The difference of colour between the Ruby and the Emerald, both of which he has discovered owes their colour to this Acid, he attributes to the different degree of oxidation of their colouring matter, the red Chromic Acid, on parting with a portion of its oxygen, becoming green; hence he supposes it to exist in a ruby, in the state of an acid, and in the emerald, in the state of an oxide.

Journal des Mines. xxxviii.

By the analysis of Vauquelin, it also appears that the CHRYSOLITE, which possesses all the external appearances of a stone. is not truly of that class, but is a salt composed of the *Phosphoric Acid and Lime*.

Annales de Chimie. xxvi.

Klaproth having analysed the APATITE found it also to be a saline substance; containing, in the proportion of 45 to 55 of *Phosphoric Acid and Lime*.

The DIAMOND, though considered as a precious stone, has long been known to be of an inflammable substance, and is now believed to be the substance called *Carbon*, existing in its most simple state, and in a crystallized form.

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A mineral substance brought from Sydney Cove, was supposed to contain a new species of earth, which was therefore termed SYDNEIAN EARTH; but Mr. Hatchett having analysed this substance, says, "I do not hesitate to assert this mineral does not contain any primitive earth or substance, possessing the properties ascribed to it, and consequently that the *Sydneian genus*, in future, must be omitted in the mineral system. *Phil. Trans.* 1798.

The stone called the CORUNDUM STONE, and from its hardness, ADAMANTINE SPAR, was also supposed to contain a new earth, which was therefore termed CORUNDA. Mr. Klaproth's first analysis of this mineral, gave Silex 31,5. Iron and Nickel 00, 05, and *Adamantine Earth*, 68. But by a subsequent analysis, by Mr. Klraproth, of this mineral, he found that it contained Alumine, from 84 to 89, Silex 5,5. to 6,5. Oxide of Iron from 1,2 to 7,5, and *no new Earth of any kind*.

AGGREGATED STONES. By the intermixture of *Quartz*, *Felspar*, and *Mica*, is formed GRANITE; and by the addition of *Hornblende*, SIENITE; and by various triple combinations of these substances with *Shorl*, *Serpentine*, *Steatites* and *Garnets*, GRANITINE; *Quartz*, *Mica* and *Garnet* compose the stone called NOREA or MURKSTEIN. The duplicate aggregates, Mr. *Kirwan* calls GRANITELL; that of *Quartz* and *Mica* the Swedes call STELL-STEIN, AVANTURINE may be considered

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as of this species ; *Hornblende* and *Mica* form the GRUN-STEIN, *Quartz* and *Steatites*, the SAXUM MOLARE ; and capillary shoots of *Shorl* in *Quartz* form the HAIR-STONE of the Germans. By GRANILITES are meant Granites composed of more than three constituent parts. GNEISS is formed like granite, of *Quartz*, *Mica*, and *Felspar*, but is of a thick slaty or fibrous texture, not granular. SHISTOSE MICA is composed of *Quartz* and *Mica*, and is of a Shistose or slaty texture, but contains more Mica than Gneiss. PORPHYRY is any stone which in a *siliceous*, *argillaceous*, *muriatic*, or *calcareous ground* contains scattered *spots of Felspar*, visible to the naked eye. It may also contain Quartz, Hornblende, and Mica. According to the ground it is named *Siliceous Porphyry*, &c. AMYGDALOID is a stone formed by elliptical masses of *Quartz*, *Lithomarga*, *Steatites*, *Hornblende*, &c. in a ground of *Trap*, *Mullen*, *Kragg*, &c. PUDDING STONES are formed by siliceous pebbles cemented together by a substance of a similar nature, or by a ferruginous compound. SANDSTONES are formed by small grains of Flint, Quartz, &c. in a ground of calcareous, siliceous, argillaceous or ferruginous kind. Sometimes these are crystallized, as in the SANDSTONE OF FONTAINBLEAU. When they contain Mica, they are termed MICACEOUS SAND STONES. Stones that have round protuberances of a different substance from the common mass are called VARIOLITES.

LITES. Stones not really porphyries, but approaching thereto, may be called PORPHYROIDS, and on the same principle is the term GRANITOID employed. Those are termed MIXED EARTHS, in which the different constituent parts are visible to the naked eye.

DERIVATIVES are earths or stones resulting from the coalition of stones and earths of different species, the different constituents not being distinct to the naked eye. LOAM is clay with a superabundance of sand. MOULD is loam mixed with the decayed remains of animals and vegetables.

VOLCANIC PRODUCTIONS.—The liquified matter issuing from volcanos is in general called LAVA. This is either *vitreous*, or *cellular*, or *compact*, or in the state of *Enamel*. Besides the lava itself, *scoriæ*, *slaggs*, *ashes*, and *sand* are produced by the eruptions of volcanos. POUZZOLANA a substance composed of *Silex*, *Alumine*, *Lime* and *Iron*; TERRASS and TUFAS, consisting nearly of the same principles as the pouzzolana. PIPERINO is a concretion of volcanic ashes, a kind of breccia; and PUMICE STONE are also produced by volcanic fires. PSEUDO VOLCANOS emit smoke like volcanos, and sometimes flame, but never Lava.

Widely different are the opinions of chemists respecting

specting the formation of various lapideous substances and the causes of the vast changes which have evidently taken place in this globe. Some, the *Plutonists*, contend that these are entirely the consequences of the action of fire, on the elementary substances of which our globe is composed. While on the other hand, the *Neptunists* attribute the same effects entirely to the powerful action of water.

Mr. *Kirwan*, who contends for the Neptunian origin of Basalt, Shorls, &c. observes that the heat communicated by volcanic fire, scarcely ever equals 120°. and that not only Shorls, which are fusible at 95°. and garnets, are ejected from volcanos unfused, but even calcareous and fluor spars, with their transparency unimpaired. These, he supposes, undoubtedly to have pre-existed in the rocks or mother stones before the eruption. In confirmation of his opinion respecting the aqueous origin of Basalt, he remarks, that this substance is converted by fire, into a most beautiful black glass, and that Mr. *Chaptal* has even converted certain kinds of Lava into glass; which he employed in casting bottles.

Dr. *Beddoes* believes the origin of Basaltes from subterraneous fusion to be thoroughly established by various authors, notwithstanding Mr. *Werner's* recent objections; he also believes there exists an affinity between granites and basaltes; that granite lavas are indeed granite rocks fused, and that they have cracked like the *basalte en tables*.

Phil. Trans. 1791.

Dr. *Hutton*, in his Theory of the Earth, differing from Mr. *Kirwan*, conceived that whinstone or basaltes, &c. attained their present position in a state of igneous fusion; but the conversion of whinstone, &c. by the heat of furnaces, into glass, was supposed to refute the Doctor's hypothesis; since, his opponents said, if fire had been the agent, glass, and not whinstone would have been formed.

Sir *James Hall*, believing that the mass might, by slow refrigeration in the bowels of the earth, have undergone a change similar to that of glass into Reaumur's porcelain; and have, by crystallization, lost the vitreous, and assumed the stoney character, fused seven different species of whinstone, and by rapid cooling reduced them to a state of perfect glass. This glass he again fused, then reduced it to about 28°. Wedgwood, in which temperature he kept it for some hours, and on allowing it to cool, the character of glass was lost, and by crystallization they had all assumed that of an original whinstone.

Abstract from the Author's Paper in Nicholson's Journal, Oct. 1799.

Dr. *Samuel Mitchill*, of New-York, observed in a stiff loam several bodies of a pentagonal figure, formed from a solid circular mass of argillaceous iron ore*, of about two feet and five inches in breadth, and four inches in thickness. In the natural fracture of the stone, the fragments took upon themselve

* *Kirwan's* 2d Variety of Family, 1st of argillaceous iron ores.

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these regular forms, very much resembling basaltes; and like basaltes, though figured, they evidently are not crystallized, for they are as perfectly ferruginous and opaque as any argillaceous iron ore whatever. Do not these specimens, the Doctor says, go very far towards deciding the dispute about the igneous or aqueous origin of basaltes? They support, he thinks, their Neptunian origin, and prove that argillaceous iron ore, which nobody has supposed to be a volcanic production, can take on a basaltic figure. *Nicholson's Journal, Feb.* 1799.

Mr. *Baume*, by a series of ingenious experiments, discovered that clays may be produced by the action of sulphuric Acid on vitrified substances. Mr. *Ferber* applied this fact to the grand operations of nature on the matters ejected by volcanos; he discovering a fine white argillaceous matter in the hollow part of vitrified lava, evidently produced by the action of the sulphuric Acid. Hence it appears that those substances which have, by the action of fire, been rendered otherwise intractable, again become, by the action of the sulphuric Acid, subservient to vegetable life.

Of the primeval State of the Earth, and its subsequent changes.

MR. *Kirwan* supposes the superficial parts of the globe to have been originally in a soft liquid state,

proceeding from solution in water heated at least to 33°· and possibly much higher. This menstruum must have held all the different earths, the metallic and semi-metallic, the saline, and the inflammable substances; being a more complex menstruum than has ever since existed. In this fluid, its solid contents coalesced and crystallized, according to the laws of elective attraction; Quartz, felspar, and mica, constituting granite, gneiss, &c. he supposes to be first deposited, with various metallic substances, particularly iron. In other tracts, according to the predominant proportion of the ingredients, were formed siliceous shistus, porphyries, jaspers, &c. with argillites, hornblende, slates, serpentines, and other primeval stones: and the metallic substances meeting and combining with sulphur, formed the pyritous substances and sulphurated ores. With the sulphur also Petrol would combine and enter into combination. By this crystallization of these immense masses, a prodigious quantity of heat must have been generated, and increased by the decomposition of the water, intercepted in the precipitated ferruginous particles, and by the disengagement of inflammable air, even to incandescence; the oxygen uniting with the inflammable air, and bursting into flame. This stupendous conflagration, supported also by the sulphurated, carbonic and bituminous substances, must have rent and split, to an unknown extent, the solid basis on which the chaotic fluid rested. From the heated chaotic fluid must have been

been extricated the oxygen and mephitic airs, which gradually formed the atmosphere. From the union of oxygen with the ignited carbon, proceeded the carbonic acid, or in Mr. *Kirwan's* words, the fixed air, the absorption of which, as the chaotic fluid cooled, occasioned the crystallization and deposition of the calcareous earth*. The immense masses, concreted and deposited by the combination and crystallization of the several earths on the nucleus of the globe, formed the primitive mountains. The formation of plains took place from the subsequent deposition in the internals of distant mountains, of matters less disposed to crystallize, such were argillaceous and ferruginous particles, and such particles of other earths, as were too distant from each other's sphere of attraction to concrete into crystals. The level of the antient ocean being lowered to the depth of 8500 or 9000 feet, then and not before, it began to be peopled by fish. That the creation of fish was subsequent to the emersion of the tracts just mentioned, he thinks, is proved, by no marine shells or petrifactions being found in tracts elevated above the height of 9000 feet, and reciprocally, of the mountains containing petrifactions, none reaches to the height of 8600 feet. After this elevated tract of the globe had been uncovered by the retreat of the sea to its bed, there is no reason to believe it remained

* The formation of fixed air being subsequent to the formation of the primeval stones, he thinks, appears from the calcareous earth being found in the composition of primeval stones, in a caustic state.

mained long divested of vegetables, or unpeopled by animals; being in every respect fitted to receive them. This retreat of the sea, from thelower parts of our present continent, was not effected, he supposes, until the lapse of several centuries; this, he thinks, is proved by the vast accumulated heaps of fossil shells, in inland situations, and the discovery of trees and vegetables in great depths, of our modern continents; and from the appearance of stratified mountains formed by gradual deposition; and thus intombing fish, shells, wood, &c. The retreat of the sea continued probably until a few centuries before the deluge, which he conceives to have originated in and proceeded from the great southern ocean below the equator, and thence to have rushed on the northern hemisphere, spread over the arctic regions and then to have descended southwards. During this elemental conflict, he supposes the carbonic and bituminous matter must have run into masses no longer suspensible in water, and have formed strata of Coal; the calces of iron, gradually reduced by the contact of bitumen and precipitated with the argillaceous and siliceous particles, forming basaltic masses, which split into columns by dessication. The eruption of fixed or oxygen air would form cavities in which, by subsequent infiltration, Calcedonies, Zeolytes, Olivins, Spars, &c. might be formed.

This system, Mr. *Kirwan* says, agrees with the geological facts related by Moses, not only in substance

stance but in the order of their succession.

Geological Essays. 1799.

OF VEGETABLE SUBSTANCES.

VEGETABLE SUBSTANCES appear to derive their chief nourishment from *Water*, which on its reception into the plant is reduced to its first principles, Hydrogen and Oxygen; the *Hydrogen* becoming an essential principle of the vegetable; and constituting the greater proportion in the composition of Resins, Oils and Mucilage; the *Oxygen* transpiring in considerable quantity through the pores of the plant; its separation being evidently accelerated by the action of light.

Nitrogen gas, so unfriendly to man, appears to be rapidly absorbed by vegetables: *Carbonic acid* gas also affords nourishment to vegetables, its base contributing perhaps to the formation of the vegetable fibre, whilst its oxygen helps to make up the great quantity of oxygen gas which vegetables throw off, by their pores.

Light is also necessary to vegetable life, it serving as a stimulus, and being also a powerful agent in decomposing the various nutritive principles; and particularly in separating the oxygen gas from the substances imbibed, whilst their bases become fixed in the plant. A sensible production of *heat* is discoverable

verable in vegetables, so as sometimes to exceed that of the atmosphere. This heat is, undoubtedly, an effect of the fixation and concretion of those matters which form the food of plants.

The SAP is that fluid which is formed by the elaboration of the various substances which are taken up as *pabula* by the plant. This fluid is generally distributed through the plant, and from it the several following matters are secreted.

1. MUCILAGE, or the *extractive principle* or *matter*, this exists in most seeds and young plants, in so great a quantity, that they are almost resolvable into it. It also forms the basis of the proper juices of the plants: and sometimes as in *Euphorbium*, *Celandine*, &c. it is combined with matters insoluble in water, which it keeps suspended in the form of an emulsion. It is sometimes found almost entirely alone, as in Mallows, Linseed, &c. Sometimes it is united with Sugar, and at other times with oil, forming the fat oils. It sometimes constitutes the permanent state of the plant, as in the Conserva, Lichens, Champignons, &c.

The characters of Mucilage are:—1, Insipidity, 2, Solubility in Water. 3, Insolubility in Alcohol. 4, Coagulation by the action of weak acids. 5, The emission of a considerable quantity of Carbonic acid, when exposed to the action of the fire, and being converted into a coal without exhibiting any flame. It likewise, when diluted with water, readily passes to the acid fermentation.

Its

Its formation seems almost independent of Light.

II. GUM exudes from different parts, but chiefly from the trunks and branches of trees. It is generally supposed to be only inspissated mucilage.

It appears to consist of *Oxygen*, *Hydrogen*, *Carbon*, *Nitrogen*, and *Lime*, with a little *phosphoric Acid*; differing from sugar, not only in containing less Oxygen, but also by its combination with Nitrogen and Lime. *Cruikshank.*

III. OILS. The oily principle appears to be the same in all Oils; but is combined with *Mucilage* in FIXED, and *Aroma* in the VOLATILE.

1. *Fixed*, or *Fat Oils* are insoluble in Alcohol, and are generally mild. They all congeal at certain degrees of diminution of heat, and are volatilized at a degree of heat beyond that of boiling water; and, when volatilized, take fire by the contact of an ignited body.

By distillation they afford phlegm, an acid, a fluid, or light Oil, much hydrogen gas, mixed with carbonic acid, and a coaly residue which affords no alkali. The volatile oils afford more hydrogen gas, and the fixed more carbonic acid gas; this last depending on the mucilage.

Oil easily combines with Oxygen. This combination is either slow or rapid. In the first case, *Rancidity* is the consequence, and combustion in the latter. It seems, more strictly speaking, that when the oxygen combines with the mucilage in the oil, it forms RANCID OIL, but that when it unites with the

oil

oil itself, DRYING OIL is formed. The rancidity of oils is therefore an effect analagous to the oxidation of metals; and the proof of its being produced by a change in the mucilage is derived from this circumstance, that if the mucilage be separated from the oil, by strong agitation in water, the oil may be preserved for a long time without any change.

If the product of the combustion of oil be collected, much water is obtained; the hydrogen and the oxygen, which the oil contained, uniting and forming that fluid. According to *Chaptal*, a pound of Oil of Olives contains 12 oz. 5 dwts. 5 grains of Carbon, and 3 oz. 2 dwts. and 67 grains of Hydrogen.

The process by which Oil is rendered drying, shows its dependence on the combination of oxygen with the oil itself, since nothing more is required than to boil oil with metallic oxides; during which process, a substance is disengaged which swims at the top, and appears to be simple mucilage.

The fixed oils unite with *Sugar*, also with the *Acids*. With the *Sulphuric* they form a mass soluble in Alcohol and Water.—With the *Nitric* they turn black, and such as are drying inflame at the time of combination. The *Muriatic* forms a saponaceous mass with them, and the *Oxy-muriatic* thickens them. They possess the power, from their affinity with Oxygen, of revivifying the metals.

The Alkalis also combine with the fixed oils, and form SOAPS by which Oils are rendered miscible with water.

The Soaps generally made in England are. 1, *White Soap*, from tallow and a ley of Soda. 2, *Mottled Soap*, from tallow, Kitchen-stuff and Soda. 3. *Yellow hard Soap* with tallow, rosin and Soda. 4. *Soft Soap*, from Whale or fish oil with pot-ash, the ley of which is not drawn off; and when it is combined, a small quantity of tallow is added, which forms the white spots.

Sir John Dalrymple proposed to use the muscular fibres of fish, in a certain proportion with tallow, to make hard soap, and to substitute it for oil, in the manufacture of soft soap. But by experiments made to determine the value of this proposal, it appears, that in making hard soap, the greater part of the fishy matter was useless, being nearly in a gelatinous state; and that it separates from the tallow, so that the fish and tallow will not combine. In attempting to make soft soap, the precariousness of the result, and its affording little or no saving renders it unworthy of attention.

R. Jameson. Nicholson's Journal 1799.

2. *Volatile* or *Essential Oils* are soluble in Alcohol. They vary in their colour, consistence, odour, &c. and are obtained chiefly by distillation. They absorb Oxygen with greater facility than fixed oils, acquiring colour and consistence, and passing to the state of Resin; depositing at the same time needle-formed Crystals, which have by some been supposed to be Camphor.

IV. CAM-

IV. CAMPHOR is a white concrete crystalline substance, which, though chiefly obtained from a species of Laurel, is said to exist in all odoriferous vegetables, and is considered as an immediate principle of vegetables. It has a strong smell and taste, is soluble in alcohol, and in acids without decomposition. With a gentle heat it rises unaltered; if ignited, it burns with a white flame, leaving no residue. It is not soluble in water, but communicates its smell to that fluid. It is capable of crystallization either by sublimation, or precipitation. It appears to be a volatile oil, rendered concrete by Carbon; and, treated with Nitric acid, yields its peculiar acid.

Romieu has observed that small pieces of Camphor obtain a rotatory motion, when placed on water, in a glass, the motion ceasing if the water be touched by a conductor of electricity, but continuing if touched by an electric *per se*. It does not turn upon hot water. *Bergen.*

Prevost and *Venturi* have remarked the curious appearances observable from the floating of Camphor and other odorant bodies on water, under different circumstances. *Annales de Chimie. XIX.*

It appears that these phenomena proceed from jets of essential oil thrown out with rapidity from these bodies, which make them move on the water.

Brugnatelli.

V. RESINS appear to be oils rendered concrete, by their combination with Oxygen. They are inflam-

flammable, and yield much soot, during their combustion; are soluble in Alcohol and in oils, but not in water. They are generally less sweet than the balsams, and afford more volatile oil, but no acid by distillation. Among the resins may be placed the *Turpentines*, the *Balsams of Mecca*, and of *Copaiba*, *Mastich*, *Sandarach*, &c.

VI. Gum Resins appear to be a natural mixture of Mucilage and Resin. They are partly soluble in water, and partly in Alcohol, and render water turbid in which they are boiled. Under this head may be placed *Scammony*, *Gum Gutta*, *Assafetida*, *Aloes*, *Gum Ammoniac*, &c.

Caoutchouc, or the *elastic Gum*, may also be placed here. The *nitric ether* dissolves this gum. If placed in contact with a volatile Oil, such as that of turpentine, it swells, softens, and becomes very pasty, and may, in this state, be applied as a varnish. A mixture of volatile Oil and alcohol forms a varnish which dries more speedily. Linseed Oil also, by long digesting on the oxides of Lead, affords a pellicle of considerable firmness; transparent, wonderfully elastic and extensible, and burning like elastic gum. A pound of this Oil, spread on a stone and exposed to the air for 6 or 7 months, acquired almost all the properties of elastic gum. *Chaptal.*

Some gum resins are cleared by art of their extractive principle, for the purpose of applying them to various uses. Such is the intention, in the process for making *Bird Lime*. Resins dissolved in

 fixed

fixed Oils form the fat or *oily varnish*; in volatile Oils the *essential varnish*; and in alcohol the *spirit varnish*.

VII. BALSAMS are substances containing a principle which does not exist in resins, and which combining with oxygen, forms an Acid, while the Oil saturated also with oxygen, forms the resinous part which is therefore found united with a concrete Acid Salt: in this class may be placed *Benzoin*, *Balsam of Tolu*, &c.

VIII. FÆCULA of vegetables appears to be only a slight alteration of mucilage, it differing from that substance, only in being insoluble in cold water in which liquid it falls with wonderful quickness. If it be put into hot water, it forms a mucilage, and resumes all its characters. It seems that the fæcula is simply a mucilage, deprived of caloric. To extract the fæcula, the plant must be bruised or ground and diffused in water; and the fæcula, which is at first suspended in that fluid, soon falls to the bottom. Thus is obtained *Potatoe flour*, *Cassava*, *Sago* &c. In obtaining *Starch*, the extractive and glutinous part is destroyed by fermentation, the fæcula or starch precipitating to the bottom. There are also *coloured fæcula*, such as *Indigo*.

IX. VEGETABLE GLUTEN. This has been called the *vegito-animal substance*, from its properties resembling those of animal substances. It is most particularly obtained from the gramineous vegetables. To procure it, a paste is formed with flour

and water, which is kneaded and wrought in the hands, under water, till it no longer communicates any colour to that fluid. The substance which then remains in the hand, is tenacious, ductile, and very elastic; and becomes more and more adhesive, in proportion as the water it had imbibed flies off by evaporation; if stretched out and let go, it returns by contraction to its former shape. During the operation the fæcula falls to the bottom of the water, and the extractive matter remains in solution.

The glutinous matter emits a very characteristic animal smell. Its taste is insipid, it swells up upon hot coals, becomes soon and perfectly dry in a dry air, or by a gentle heat, in which state it resembles glue, and breaks short like that substance. If in this state it be placed on burning coals, it curls up, is agitated and burns like an animal substance. By distillation it affords the carbonate of ammoniac, and shews in several instances a very decided animal character.

Fresh made gluten, exposed to the air, readily putrifies, and when it has retained a small quantity of Starch, this last passes to the Acid fermentation and retards the putrefaction of the gluten: in this way a state is produced resembling that of cheese.

Cold Water does not attack this glutinous part; but if it be boiled with this fluid, it loses its extensibility and adhesive quality: it also loses its elasticity and glutinous quality by drying. *Alkalis* dissolve

it, by the assistance of a boiling heat, and it is precipitated by *Acids*, but deprived of its elasticity.

The *nitric Acid* dissolves it with activity, emitting at first the nitrogen Gas, as when an animal substance is employed. This is followed by an emission of nitrous Gas, and the residue affords by evaporation, the oxalic Acid in crystals.

The *Sulphuric* and *Muriatic Acids* likewise dissolve it, and salts with base of ammoniac, may be obtained from the combinations.

Dissolved repeatedly in *vegetable Acids*, and precipitated by alkalis, it is brought to the state of fæcula; and if vinegar be distilled from it, it is reduced to the state of mucilage.

It is to this gluten, that wheat owes its property of making a good paste with water, and the facility with which it rises.

This gluten is sometimes destroyed by the fermentation of flour, by which change it is rendered incapable of rising and forming good bread.

FARINA, or flour therefore is composed of three principles, the *Amylaceous*, or *Starch*, or *Fæcula*, the *animal* or *glutinous* principle, and the *saccharine principle*.

X. SUGAR is likewise a constituent part of vegetables, it may be extracted from a number of plants, as the maple, birch, wheat, corn, beet, parsnips, grapes, &c. by digesting in alcohol. This fluid dissolves the sugar, and leaves the extractive matter untouched, which falls to the bot-

bottom. The sugar generally used, proceeds from the sugar-cane, *Arundo Saccharifera*. The juice of the cane is obtained by expression, and boiled repeatedly with wood-ashes, and lime, until it acquires a syrupy consistence. It is then farther concentrated by boiling with alum and lime, and the thinner syrup allowed to separate from the sugar, which in this state is called *clayed sugar*. This sugar suffers here a farther refinement, by boiling with lime and with bullocks blood, which latter, coagulating by heat, involves and separates most of the foreign matters it contains, thus producing its clarification, when it is called *refined* sugar. If allowed to crystalize, it will form tetrahedral prisms, with dihedral summits, and is then called *sugar candy*.

The carrot, and the *beta cycla altiss*, yield sugar in considerable quantity. The water remaining after obtaining starch, also contains a large quantity of sugar. *Prof. Jacquin and Dr. Peschiere.*

From the ingenious inquiries of Mr. Cruikshank, it appears that, 1. sugar is a pure vegetable oxide, consisting of carbon, hydrogen, and oxygen. 2. sugar of milk differs only in containing more oxygen, and much less carbon. 3. Gum differs also in containing lime and azote. 4. Vegetable farina cannot be converted into saccharine matter, without the joint action of oxygen and water, the first being absorbed, the latter decomposed. 5. Sugar deprived of its oxygen, loses its characteristic properties, appears

somewhat like a gum, and is no longer susceptible of the vinous fermentation. 6. Neither vegetable nor animal mucilage, in their pure state, are susceptible of this process.

Experiments on the nature of Sugar. Wm. Cruikshank.

XI. VEGETABLE ACIDS.

FIRST, *Vegetable Acids ready formed, and obtained by very simple processes.*

THE CITRIC ACID, or the expressed *juice of Lemons*. This is obtained in a concrete state, by saturating it with powdered Chalk; it thereby forming a difficultly soluble Salt, CITRATE OF LIME, which is to be washed with warm water, and then a sufficient quantity of sulphuric Acid to saturate the Chalk employed, is to be added, then boiled for some minutes, with ten parts of water, and then filtered; when the sulphate of Lime remains on the filtre, and the fluid, by evaporation, will yield the CRYSTALIZED CITRIC ACID. It may be strongly concentrated, by freezing the water it contains. It seems to be one of the strongest of the vegetable Acids; it is not converted by the Nitric Acid into the Oxalic Acid. It acts on several metallic substances by the aid of water, and forms CITRATES with the *Alkalis* and *Earths*.

M.

M. Brugnatelli obtained Citric Acid pure, by well straining it through linen cloth, then mixing it with spirits of wine, and, after standing some days, filtering it through paper; the pure Citric Acid passing through, and the slimy matter being left on the paper. *Annales de Chimie.* XXII.

THE MALIC ACID may be extracted from the juice of ripe fruits, particularly from apples, by saturating the juice with chalk, and adding a solution of acetite of Lead; the acetous Acid combining with the alkali, and the lead with the malic Acid, forming a MALATE OF LEAD, which is precipitated. This precipitate being washed, and diluted sulphuric Acid added to it, sulphate of Lead is formed, and the malic Acid left.

With the *Alkalis* it forms deliquescent salts; with the *Earths* it also forms MALATES, that of alumine being difficultly soluble. The MALATE OF IRON does not crystallize, but that of *Zinc* forms in fine crystals. It precipitates the *Nitrates of Lead*, of *Silver*, or of *Gold*, in the metallic state. It is readily destroyed by fire, or converted into the carbonic Acid. Besides fruits, many of which yield both it, and the citric Acid, sugar also yields it, when treated with nitric Acid. The nitric Acid changes it into the oxalic Acid.

THE GALLIC ACID may be thus obtained. One pound of powder of nut galls may be infused in two pints and three-quarters of water, for four days, shaking the mixture frequently, and then filtered

tered and left in a vessel covered merely with blotting paper. The liquid will then become covered with a thick pellicle of mouldiness, and a precipitate falls down in proportion as the infusion evaporates. These precipitates being collected, and dissolved in boiling water, form a liquor of a brown yellow colour, which, on evaporation by a gentle heat, deposits the Acid in a precipitate like fine sand and crystals of a yellowish grey, it not being possible to obtain it white.

It yields an acid astringent taste, it effervesces with chalk, and reddens turnsole. Half an ounce of this salt is soluble in an ounce and an half of boiling water, or in twelve ounces of cold water. Boiling spirit of wine dissolves its own weight of this Acid; but cold spirit only one fourth.

It is inflammable, it also melts and leaves a coal of difficult incineration. By distillation it gives out an acid phlegm, and a sublimate nearly of the smell and taste of Acid of Benzoin.

It precipitates the several metals in different colours. *Gold*, of a *brown colour*; *Silver*, of a *grey*; *Mercury*, of an *orange*; *Copper*, of a *brown*; *Lead*, of a *white*; and *Iron*, of a *black colour*.

The basis of INK is iron thus precipitated. One pound of powdered nut-galls being infused four hours, without boiling, in common water, with six ounces of gum arabic, and six ounces of sulphate of Iron or green Copperas, good black ink is produced.

This

This Acid is changed into the oxalic Acid, if the nitric Acid be distilled from it.

The decoction of galls contains, besides that which is known as the proper ACID OF GALLS, a substance, which from its properties is named TANNIN, or the TANNING PRINCIPLE.

To obtain these separately, a solution of *muriate of tin* must be added to the decoction of galls, a precipitate falls, containing the *tanning principle* and oxide of tin, the liquor holding the *Acid of Galls*, muriatic Acid, and muriate of Tin.

To obtain the *Acid of Galls* alone, the tin is separated in a sulphurated oxide, by the addition of sulphurated hydrogen gas, and the remaining liquor yields the Acid by appropriate filtration, evaporation, and washing of the crystals.

The TANNING PRINCIPLE is separated from the oxide of tin, by diffusing the precipitate in water, and exposing it to a current of sulphurated hydrogen gas, when the sulphurated oxide of tin falls down, leaving the pure tanning principle dissolved in the water, from which it is obtained by filtration, and evaporation, in a dry, brown, friable mass, of an acerb, bitter taste, soluble in hot water and in alcohol. Its aqueous solution lathers like soap water, and being poured into a solution of glue, it directly converts it into a magma, which possesses the elastic properties of the gluten of wheat. It is, in a word, the *preserving principle of tanned leather.*

The

The green sulphate of iron is not altered by the tanning principle, any more than by the Acid of galls. But the red sulphate is precipitated by the tanning principle, in a somewhat tarnished blue deposition, different from that by the Acid of Galls. Besides, the GALLATE OF IRON is soluble in Acids, but the TANNATE OF IRON is decomposed by these salts. *Proust, Annales de Chimie.* XXV.

THE BENZOIC ACID is obtained by adding *Lime-water*, by degrees, to powdered Benzoin, stirring them together over a gentle fire for half an hour, by which, the Acid uniting with the Lime, the BENZOATE OF LIME is formed. After settling, the clear liquor is poured off, and the process twice repeated with fresh lime-water. The liquors should be then filtered, and muriatic Acid added as long as any precipitate, which is the ACID OF BENZOIN, falls. To have its crystals, it must be dissolved, filtered, and gently evaporated. It may be also obtained by *sublimation*.

It reddens the infusion of violets, effervesces with the alkaline carbonates, and unites with earths, alkalis, and metals, forming BENZOATES. A similar Acid is obtained from *Balsam of Tolu* and *Storax*.

The effects produced on it by the *nitric Acid*, are not thoroughly known. It differs, however, from the other vegetable Acids, and retains an essential oil, which gives it smell, volatility, combustibility, and solubility in alcohol.

ACID-

ACIDULES or *Vegetable Acids, partly combined with Pot-Ash.*

TARTAREOUS ACIDULE, or TARTAR, is formed on the sides of casks during the insensible fermentation of Wine. It is formed also in Must, or unfermented Wine, and in several fruits. Exposed to heat it yields Carbonic Acid, Oil, Phlegm and Ammoniac, and leaves, in its ashes, a considerable quantity of vegetable Alkali.

ACIDULOUS TARTRITE of POT-ASH, or CREAM of TARTAR, is obtained by solution of the above, and subsequent filtration and evaporation. It crystallizes in tetrahedral prisms, cut off slantwise.

THE ACID OF TARTAR may be obtained, by dissolving two pounds of Crystals of Tartar in water, and throwing in chalk by degrees, until the liquid is saturated. A precipitate forms which is a true TARTRITE of LIME, tasteless and crackling between the teeth. By adding nine ounces of Sulphuric Acid and five ounces of water to this Tartrite, and digesting them together for twelve hours, the tartareous acid is set at liberty, and may be cleared from the sulphate of Lime by means of cold water. This Acid yields crystals which become black when exposed to the fire, yielding an acid phlegm and some oil, and leaving a spongy coal behind. This acid is very sharp, but has no action on *Platina, Gold, Silver,*

Silver, or *Antimony*, and scarcely any sensible action on *Copper*, *Lead* and *Tin*; but it dissolves their *Oxides*. It acts on *Iron* with a considerable degree of effervescence. With the *Earths* it also combines very freely. With *Ammoniac* it forms an ammoniacal tartareous salt, which crystalizes very well, and acquires a greater degree of solubility when combined with *Borax*.

It is by the combination of this Acid with *Pot-ash*, that the acidulous tartrite of pot-ash, or cream of tartar, is formed. In this substance the Acid exists in excess, and is therefore capable of entering into farther combinations, forming *triple salts*. Such is the TARTRITE OF SODA, formerly called *sal rochelle*, or *sel de seignette*, which crystalizes in tetrahedral, rhomboidal prisms.

OXALIC ACIDULE, or *salt of sorrell*, consisting of oxalic Acid and oxalate of pot-ash, is obtained from the juice of the *oxalis acetosella*. It forms small white needle-like crystals, of a penetrating austere taste, and as it unites with other bases, without quitting its own, like the acidulous tartrite of pot-ash, it also forms triple salts with the alkalis, earths, and some of the metals.

The OXALIC ACID obtained from the oxalic acidule, by depriving it of the pot-ash it contains, has a penetrating sour taste, it effervesces in the air, is soluble in twice its weight of cold, and half its weight of hot water. It combines with *alumine*, *magnesia*, and *barytes*. Its affinity with *Lime* is such

such that it takes it from every other substance, forming an almost indecomposable OXALATE OF LIME. It is therefore employed to discover this earth in combination or solution. It also forms oxalates with the *Alkalis*, making, with *Pot-Ash*, the oxalic acidule, or the Salt of Sorrell of the shops. It combines more readily with *metallic oxides*, than with the *metals* themselves. With *Arsenic* it forms very fusible volatile crystals; with *Cobalt*, a light rose-coloured pulverulent salt; with *Nickel*, a greenish yellow salt; with *Calx* of *Bismuth*, a salt in powder; with *Calx* of *Antimony*, in crystaline grains; with *Manganese*, a powder becoming black by heat; with *Zinc*, a white pulverulent salt; with *Tin*, if the solution be slowly evaporated, it forms *prismatic crystals*; if quickly, *a transparent mass* like horn; with *Lead* it forms white, with *Iron* greenish, and with *Copper* light blue crystals. An OXALATED SILVER is obtained by adding this Acid to the nitrate of silver in solution: it also dissolves the precipitate of *Platina*, by soda; but has scarcely any action on the *calx of gold*.

Brugnatelli says that the oxalic Acid cannot be depended on as a reagent on Lime, since he discovered that in several instances the presence of Lime was ascertained by other known reagents, when the oxalic failed. *Annales de Chimie*, No. 86.

VEGETABLE

VEGETABLE ACIDS *obtained by the use of* NITRIC ACID.

SUGAR, MUCILAGES, MILD OILS, FLOUR, and even a great number of *Animal Substances* afford, when heated with the nitric Acid, an acid perfectly similar to the Acid last described. These substances contain, therefore, the *oxalic radical*, to which oxygen only is wanted, to convert it into oxalic Acid; this acid, like other vegetable acids, being probably a compound of Hydrogen, Carbon, and Oxygen. *Berthollet* obtained from *Wool* more acid than half the weight of it. Since several vegetable acids, and in particular that of *Tartar*, pass to the state of oxalic by the addition of the nitric Acid, we may conclude these vegetable acids have the same radical, and differ only in the proportion of Oxygen.

CAMPHORIC ACID, which is obtained by means of the Nitric Acid, seems to differ in some respects from the Oxalic. It yields crystals resembling the muriate of ammoniac, which are very sparingly soluble in water. With *Pot-ash* it forms crystals in regular hexagons; with *Soda*, irregular crystals; with *Ammoniac* it forms needle-formed crystals and prisms; with *Magnesia* a white pulverulent Salt. It dissolves *Copper*, *Iron*, *Bismuth*, *Zinc*, *Arsenic*, and *Cobalt*; the solution of *Iron* yielding a yellowish white, insoluble powder. With *Manganese* it forms crystals

crystals whose planes are parallel, and in some respects resembling basaltes.

It burns without leaving any residue, does not precipitate lime from lime-water; nor does it produce any change in the sulphuric solution of indigo. Its salts exhibit a blue flame with the blow-pipe.

Bouillon la Grange. Annales de Chimie. XXIII.

SUBERIC ACID, obtained, as it name imports, from *Cork*, also differs from the oxalic; and unlike the Camphoric, it turns the sulphuric solution of Indigo green.

ACIDS *obtained by the* ACTION OF HEAT, or EMPYREUMATIC ACIDS.

PYRO-TARTAREOUS ACID is yielded by distillation by the *tartareous Acidule*. The acid thus obtained, seems not to be the pure acid of that substance, but to have suffered a change from the action of fire; it is therefore called *pyro-tartareous*; and its saline combinations, PYRO-TARTRITES. Many conjectures have been formed respecting this acid, but it is probable, that it possesses no other principles than those of the tartareous acid itself, from which it seems only to differ in the quantity and proportion of those principles.

PYRO-MUCILAGINOUS ACID is obtained by distillation from *insipid*, *saccharine*, *gummy*, or *farinaceous* mucilages. It is a penetrating Acid, renders the skin of a red colour, and forms PYRO-MUCITES with the *Earths* and *Alkalis*, with *Lead*, *Copper*, *Tin*, and *Iron*.

PYRO-LIGNEOUS ACID is obtained by distillation from *wood*, and particularly from *Beech*, *Birch*, and *Box*. With earthy and alkaline bases it forms PYRO-LIGNITES. It acts on several metals, and dissolves most of their oxides.

FERMENTATION OF VEGETABLE SUBSTANCES.

FERMENTATION takes place, accompanied by a decomposition, when the various parts of vegetables are diffused in water, and the action of this fluid is favoured by the combined aid of air and heat.

The first agent of fermentation appears to be oxygen gas, which is afforded either by the atmosphere, or by the decomposition of the water: oxygen gas being absorbed, and caloric separated during the process.

When the *saccharine principle* predominates in the substances employed, the product is a *spirituous liquor*, and the process is termed, the *spirituous fermentation*; but when *mucilage* is most abundant, the liquor soon manifests an Acid, the process by which it is formed being termed the *acetous fermentation*; and if gluten be prevalent, ammoniac will be discovered in the product, and the process will be the *putrescent fermentation*. No substances but those which consist simply of carbon, hydrogen and oxygen are susceptible of the vinous fermentation. It appears that Nitrogen and Lime combined with the Carbon

Carbon, in Gum, prevents the vinous, and consequently the acetous fermentation.

SPIRITUOUS FERMENTATION is employed for making *Wine*, *Cider*, *Beer*, *Perry*, &c. These, by distillation, yield an ardent and inflammable spirit, possessing an aromatic and resinous smell, a penetrating and hot taste, and an inebriating quality.

ALCOHOL or SPIRIT OF WINE, which is thus produced, appears to be formed by an intimate union of much hydrogen with carbon, Mr. *Lavoisier* obtained eighteen ounces of water by burning one pound of Alcohol. Spirit of Wine is the proper solvent of resins, and essential oils, and hence of material use in various arts.

ETHER is formed by the combination of oxygen with alcohol. It may be formed by employing almost any of the acids, by distilling them with an equal quantity of alcohol: the acid is hereby decomposed, its oxygen combines with the hydrogen and the carbon of the alcohol, and produces, 1. a very volatile fluid, or *Ether*; 2. Etherial Oil, and 3. Bitumen. Ether is light, exceedingly volatile and of a peculiar smell; is sparingly soluble in water, burns readily, and with a blue flame.—Digested on sulphuric Acid, an etherial oil is produced. *Chaptal.*

That Ether is produced by the combination of Oxygen with the Alcohol, appears from an etherial liquor having been produced by repeated distillation of alcohol from the red oxide of mercury. It is however

however said that Mr. *Fabroni* has proved that Alcohol is not necessary to the formation of Ether, he having prepared it without the aid of vinous spirit.

Gren's Annals.

Hoffman's Anodyne Liquor is made by uniting two ounces of spirit of wine with two ounces of Ether and twelve drops of sweet oil of wine.

Messrs. *Bondt*, *Deiman*, *Van Troostwyk*, and *Lawrenberg* have discovered that by the distillation of Ether, or of a mixture of sulphuric Acid with Alcohol or Ether, or by causing the vapours of Alcohol and Ether to pass through a tube of clay ignited, or through the component parts (alumine and silex) of such a tube, a gas is obtained, which they have called the *carbonated oily hydrogenous gas*: which on being mixed with oxygenated muriatic acid gas, manifests the extraordinary property of forming an oil. But if the distillation be made through a glass tube, or if this gas be made to pass through a glass tube, the property of forming oil is lost, carbon being deposited. *Annales de Chimie.* XXI.

ACETOUS FERMENTATION appears to depend, as has been just remarked, on the mucilaginous principle. Vegetables or their juices containing this principle, being exposed to the air, become heated, and the liquid parts turbid; a lively smell is emitted, and much air is absorbed. After some time, a considerable quantity of lees settle, leaving above them a clear acid liquor.

VINEGAR being thus formed, may be concentrated by distillation, or by freezing.

ACETOUS ACID, or *distilled* or *concentrated Vinegar*, united with *Pot-ash*, forms the ACETITE OF POT-ASH, also called improperly *Terra foliata Tartari*; with *Soda*, the ACETITE OF SODA; and with *Ammoniac*, the AMMONIACAL ACETITE, generally known by the name of *Mindererus's Spirit*.

ACETIC ACID, also called *Radical Vinegar*, has been supposed to be formed by introducing a still larger quantity of Oxygen, than it in general contains into the acetous Acid. To do this, the acetous Acid is combined with some of the metallic oxides, and exposed to distillation, when the oxygenated Acid is obtained. *Adet* believes, 1. that the Acid of Vinegar is *always* at the highest possible degree of oxygenation, and consequently *always*, acetic; 2. That no such thing as acetous acid exists, and 3. that the difference arises only from the proportion of water the acids contain.

Chaptal agrees with *Adet* in the first of these positions; but asserts that an actual difference between the two acids exists, arising from a smaller proportion of carbon in the acetic Acid than in the acetous; he also says, that it is in the *acetous* state in metallic salts, and that it does not pass to the *acetic state*, but by *decarbonization*.

Annales de Chimie, 1798.

Acetic Acid is very acrid and volatile, emitting, when

when heated, an inflammable vapour, and forming with alkalis and earths, salts different from those formed by common vinegar, and which are distinguished by the term ACETATES. It will also form Ether with Alcohol.

The presence of Spirit of Wine, Mucilage and Air, is supposed to be necessary to the formation of Vinegar. *Scheele* has formed it by decomposing the nitric Acid on sugar and mucilage.

X. ALKALIS exist in plants combined with oils, acids, &c. and sometimes very slightly engaged. They are generally obtained by destroying all the other principles of the plant by fire. The alkali, in general, obtained from vegetables, is *Pot-ash*. Marine plants yield *Soda*. Plants also are found to contain *Ammoniac*, as well as neutral Salts formed by the combination of the Acids with the Alkalis. Whilst considering the alkalis thus discovered in plants, we are however not to omit to reckon on the considerable effects attributable to the combinations which ensue, in consequence of combustion. The atmospheric air, during this process, will unite with some of the vegetable principles, and produce certain results: and perhaps the nitrogen may, by its union with certain principles, form alkalis, or at least augment or acuate those which existed in the plant.

With respect to the existence of ammoniac in vegetables, it must be observed that, besides the spirituous and the acid fermentation just treated of;

vegetables,

vegetables, as by a natural termination, run into another, the PUTRID FERMENTATION. This decomposition takes place when vegetables are heaped together, and softened with the humidity with which they are impregnated, and by their own effused juices. Their colours change, the mass becomes of a dark brown, swells, and becomes heated, and as it is reduced to a magma, a gas is disengaged, which is a mixture of *nitrogen*, *hydrogen*, and *carbonic Acid*; *ammoniacal Gas* is also emitted. The whole is at last resolved into a brown mass, which for the most part forms vegetable mould, being a mixture of all the primitive earths, and of the metals which are found in vegetables as well as the oil, salts, &c. This residue of vegetable decomposition may be considered as the great agent and means by which nature repairs the continual losses the mineral kingdom undergoes, diamonds, quartz, crystals, spars, bog-ores, &c. being formed in this matrix.

XI. The COLOURING PRINCIPLE is found in vegetables in four states of combination :—

1. with the extractive principle, as in logwood, cochineal, &c.
2. ——— resinous principle.
3. ——— fecula, as archil, indigo, &c.
4. ——— gummy principle.

The object of the *art of dyeing*, is to transfer the colouring principle of one body to another, so that it shall be durably fixed.

Colours are all formed in the solar light; the various

ous tinges of colours resulting from the absorption of some of the rays of light, and the reflection of others. By the art of dyeing, a substance possessing the property of reflecting particular coloured rays, is transferred to the surface of another body.

When the colouring principle is held in a substance of the nature of extracts, water dissolves the whole of it as in logwood, madder, &c. Into an infusion of this colouring substance the stuff to be dyed is therefore plunged. But this being soluble in water, is liable to be removed by washing, it is therefore necessary to give it fixity, by depriving it of its solubility; the substance which is employed for this purpose, is called the *mordant*, and must have an affinity with the colouring principle and with the stuff itself. Thus, for the purpose of obtaining a fine scarlet from *cochenille*, tin must be employed as a *mordant*.

Some resinous colouring matters are only soluble in spirit of wine, and are therefore only used in the smaller articles, such as ribbons, &c. Other colouring matters are combined with *fæcula*, which water alone does not dissolve, such are *Archill*, *Indigo*, &c. The colouring matters of this class are, however, all soluble in alkali, or lime; these substances are therefore used to dissolve them in water, that they may be precipitated upon stuffs. This may be done by the addition of an acid. Acids may be used instead of alkalis, in fixing some of these colours

upon

upon stuffs, thus may indigo be dissolved in the acid of vitriol, instead of in lime. Some colouring principles are fixed by a *resin* ; but which, by the assistance of *extractive matter*, may be suspended by water. Stuffs being boiled in this solution, the resinous part applies itself and adheres, so as not to be liable to be again carried off by water. The chief substances of this kind are *Sumach*, *Santal*, *the husks of Walnuts*, &c. The colouring matter of some vegetables are only extracted by *oils*, such is the *Alkanet Root*.

The stuff, preparatory to the application of the colouring matter, must be cleared of all glutinous matter which belongs to it in its natural state ; it must also be bleached and impregnated, when that is necessary, with the mordant.

The removal of the glutinous matter from the fibres of the stuff which would prevent the reception of the colour, is accomplished by washing in a solution of soap, of alkali, and particularly of soda. The operation of bleaching, or whitening, which will much contribute to the brilliancy of the subsequent colour, depends on the action of oxygen, which combines with the colouring principle, and destroys it. The most common mode is that of boiling the pieces in an alkaline lixivium, and exposing them afterwards to the air, to render the whiteness more perfect. But the oxygenated muriatic acid produces

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the effect with so much facility, that all former processes must yield to it.

The piece being prepared so far by these processes, it is then impregnated with the mordant or principle which is to receive the colour, and render it incapable of extraction. The sulphate of alumine and the muriate of tin are the two salts which are most efficacious for these purposes. The stuff thus impregnated, is then passed through the colouring liquid, and by the decomposition or change of principles between the mordant and the principle which holds the colour, in solution, the colour is precipitated on the base of the mordant, and adheres to it.

Some vegetable substances are likewise disposed to take some colours by being animalised. In this way, cow's dung and bullock's blood are used in dyeing cotton.

Turnsol has been discovered to be made by finely powdered Lichen, Archil, or even the greater moss of the oaks, first mixed with an alkali, and kept moist with human urine; it becoming red and then blue, when it is mixed with one third of pot ash, by remaining with which it acquires a dark blue colour. It is then made into cakes, by a mixture with chalk, to increase the profit. *Journal de Commerce.*

The juice of aloes produces a lively violet, highly proper for works in miniature, and which may serve, either cold or warm, for dyeing silk, from the lightest to the darkest shade.

Fabroni. Annales de Chimie, xxv.

Brug-

Brugnatelli obtained, by distilling the Nitric Acid from Indigo, a peculiar resin, of a deep yellow colour, and of half the quantity of Indigo employed.

Annales de Chimie. LXXXVII.

Guyton supposes the red colour of fruits to be owing to the reaction of their own acid on the colouring matter: and that tin, in restoring the colour of violets, attracts from it the acid which had turned it red: lead, bismuth, zinc, antimony, and particularly iron, doing the same. The metallic oxides are not equally powerful; but the Oxide of Tungsten, he thinks, is superior to all others, in forming cakes for painters.

La Decade Philos, 1798.

XII. POLLEN, or the fecundating powder of the stamina of vegetables, is generally of a resinous nature, soluble in alkalis and alcohol. Like resin it is inflammable, the *aura* round certain vegetables, may, it is said, at the time of fecundation, be set on fire.

WAX OF BEES is merely the Pollen very little altered.

There appears to exist in the very texture of some parts of various vegetables, a matter analogous to wax.

It appears that wax and the Pollen have for their basis, a *fat oil*, which passes to the state of resin by its combination with oxygen. If the nitric or muriatic Acid be digested on fixed oil for several months, it passes to a state resembling wax.

Wax, by repeated distillations, affords an oil possessing all the properties of volatile oils. It is reduced into water and carbonic Acid by combustion.

Alkalis dissolve wax, and render it soluble in water. It is this saponaceous solution which forms the *Punic Wax*, which may be used as the basis of several colours, and may be made into an excellent paste for washing the hands. It is likewise used with a brush, as a varnish on several bodies: but it would be highly advantageous if it could be deprived of its solvent, which constantly acts, and is the cause why it cannot be applied to several uses, in which otherwise it might be found advantageous.

Ammoniac likewise dissolves it; and as this solvent is evaporable, it ought to be preferred when it is proposed to use the wax as a varnish. *Chaptal.*

XIII. HONEY, or the Nectar of Flowers, is contained chiefly in the Pistil or female Organs. It appears to be a solution of sugar in the mucilage.

XIV. The LIGNEOUS part of the Vegetable, forms the vegetable fibre; and not only constitutes the basis of the vegetable, but also the husk of seeds, lanuginous coverings, &c. Its character is insolubility in water, and almost every other menstruum, even the concurrence of air and water alters it very difficultly, and so absolutely resists every kind of fermentation, as to be almost indestructible, but by insects.

Besides those already mentioned, various other principles

principles have been found in the vegetable kingdom. *Sulphur*, in substance, is said to be found in the dried scum which rises from the herb *Patience*, whilst boiling in water. *Iron*, *Manganese*, and even *Gold*, have been found in the ashes of plants. *Lime*, *Alumine*, *Magnesia*, and *Baryt* are also found in plants, the first abundantly, the last less commonly. *Silex* has been found within the joints of the Bamboo.

Bonnet cane and all cane of this kind, when briskly rubbed together, produce sparks of white light, and when violently struck together, sparks, nearly as vivid as those from a gun-lock, are perceived, and a strong smell at the same time produced. Similar effects followed when the cane was sharply struck by steel or any siliceous stone. These phenomena appear to proceed from the epidermis of the cane containing Silex; 22 grains of epidermis yielding about 9 grains of Silex. From 240 grains of the internal part of the cane, about 2 grains apparently Silex were obtained. Other canes yielded much less Silex; but it was found in the English reeds and grasses, in wheat, oats, barley, &c. Possessing also Carbonate of Pot-ash with the Silex, they yield glass by the blow pipe, a straw being thus converted into a fine pellucid globule of glass.

Mr. H. Davy. Nicholson's Journal, May, 1799.

The epidermis of the *equisetum hyemale*, or dutch rush, appears to be almost wholly composed of Silex. Mr. *Notcutt* obtained a globule of glass from it by the blow-pipe. *Phil. Journal.*

The Sap is, as has been already remarked, the general humour of vegetables, as the blood is of animals, and from this are secreted the proper juices of different vegetables. The saps of the elm, the beech, the service, the birch, and the mulberry trees appear to differ considerably in their composition; but the acetous acid seems to be found in all; and the alkali is united with the acetous and carbonic Acids, in the form of Neutral Salts.

Vauquelin, Annales de Chimie, 1791.

MANNA is secreted and exudes from several vegetables, from the pine, the fir, the maple, the oak, the juniper, the fig, the willow, the olive, &c. but the ash, the larch, and the alhagi, afford it in the largest quantities. OPIUM is formed by the poppy.

Some of the juices of plants are distilled from incisions purposely made in the plant, whilst the more succulent vegetables yield their juices by pressure.

Vegetables appear to be endued with digestive organs, and to possess the power of digesting and assimilating those substances, which are taken up by their absorbents, and which are congenial to their nature. They also are capable, not only of throwing off those substances which cannot be assimilated by them, but even such of their principles as may exist in excess. Thus Oxygen is emitted both from land and aquatic plants, in very considerable quantity, during their exposure to the action of light; and by this

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continual emission of vital air, is the loss repaired which is occasioned by respiration, combustion, fermentation, and putrefaction.

The Oxygenated Muriatic Acid, mixed in the proportion of half a cubic inch of acid and three cubic inches of water, made into a paste with the black Oxide of Manganese and seeds, produced the germination of seeds, which no efforts before could cause to vegetate. The application of Oxygen, in a mode somewhat similar to the roots of plants, appears also to promote vegetation.

Humboldt. Journal de Physique, 1798.

Plants likewise emit a very considerable quantity of water in the form of vapour. The water which thus exhales is not pure, but serves as the vehicle of the aroma, and even of a small quantity of extractive matter.

XV. AROMA is the odorant principle in vegetables, which from its fineness, its invisibility, &c. appears to be of the nature of gas. It varies much, in different plants; and, according to its volatility and affinities, is extracted either by oils, water, or alcohol; and by simple infusion or by distillation. When water is used, it is termed the *distilled water*, and when alcohol is employed, it is called the *spirit* of the vegetable acted upon.

Vegetables being exposed to the joint action of heat and air, the oxygen combines with the inflammable principles of the plant, and combustion takes place

place with the production of smoke, snd the disengagement of heat and light. The smoke is a mixture of water, oil, volatile salts, and all the gaseous products which result from the combination of caloric and oxygen with the several principles of the vegetable. With the smoke arises soot, partly composed of substances imperfectly burned, having escaped the action of the oxygen Hence the soot may be again burned; and hence it is, that where, as in the lamps of Argand, and in violent furnaces, where the combustion is more perfect, there is no perceptible smoke. Soot, by analysis, yields an oil, a resin soluble in alcohol, an acid formed by the decomposition of mucilage, also volatile salts, such as carbonate of ammoniac, and other neutral salts. The fixed principles remaining after the combustion, form the ashes, containing salts, earths, and metals already treated of.

DISTILLATION occasions a separation of the principles of vegetables, all vegetables yielding nearly the same, viz. an *oil*, an *acid*, *water*, a *concrete salt*, and a *caput mortuum*, or *charcoal*.

CHARCOAL has already been treated of under its more modern name, Carbon, but is here again considered as one of the principles of vegetables, and for the sake of mentioning one or two properties of this substance, which were omitted in their more proper place.

Charcoal is obtained from wood by the process termed

termed *Charring*, which is, burning it whilst the air is as far excluded as possible, and yet to allow the combustion to proceed. It appears, indeed, to be the vegetable fibre very slightly changed, and when pure, has neither smell nor taste, and suffers no change by boiling in water. When moist, it affords an hydrogenous gas, termed HYDRO-CARBONATE, formed by the decomposition of both substances. M. Lavoisier demonstrated that charcoal of wood might be almost entirely converted into Carbonic Acid by its union with oxygen.

OF

OF ANIMAL SUBSTANCES.

I. THE GASTRIC JUICE is secreted in the stomach of animals, and produces the digestion of their food, which may be considered almost as a chemical process; the aliment being dissolved by the gastric juice, independent of trituration, except in such animals as ducks, geese, pigeons, &c. who have strong muscular stomachs, for the express purpose of aiding the digestion of the food by the process of trituration. The gastric juice varies in different animals, according to the nature of their aliments: this difference extending to its chemical properties, and hence a variety in the analysis of the gastric juice of different animals. It, however, in general yields water, animal gluten, and salts.

II. MILK is secreted in the breasts of female lactiferous animals, but the following observations will chiefly refer to that of cows. It is the least animalized of all the secreted fluids, partaking of the nature of the chyle, and even of the qualities of the aliments. When exposed to the air, *cream* rises on its surface, the remaining *skimmed milk* becoming sour, in a longer or shorter time, according to the temperature of the atmosphere: in summer acquiring its greatest acidity in three or four days, and separating into a *coagulum* or *curd*, and a *serum* or *whey*.

LACTIC ACID, or the ACID of MILK, is thus obtained. Sour milk being evaporated to one eighth, the cheesy matter separated by the filter, and *Lime-water* poured on the residue, an earth is precipitated, and the lime combines with the acid of the Milk. The Lime may then be displaced, by adding the *oxalic Acid*, which forms with it an insoluble oxalate and is precipitated, the acid of Milk remaining disengaged. The fluid is then evaporated to the consistence of honey, and upon this very pure alcohol is poured, which takes up the acid, all the other principles remaining undissolved. The mass being now filtered, the lactic acid may be separated from its solvent by distillation.

The lactic acid forms deliquescent LACTATES with the *Alkalis*, *Baryt*, *Lime*, *Alumine*, *Magnesia*, *&c.* It dissolves *Iron* and *Zinc*, and produces hydrogen gas. With *Copper* it assumes first a blue colour, then a green, and afterwards an obscure brown. It also dissolves *Lead*, the solution depositing a white sediment, considered by *Scheele* as a sulphate of Lead, and as evincing the presence of a small portion of sulphuric in this Acid.

SUGAR OF MILK is obtained from milk, deprived of its cream and of its curd, and evaporated to the consistence of honey. This is formed into cakes, which are dried in the sun, then dissolved, clarified, and set to crystalize; it then yielding white crystals, in rhomboidal parallelopepidons. It has a slight earthy saccharine taste, is soluble in three or four

pints of hot water, and exhibits the same appearances as sugar, either by distillation, or on the fire. By distilling the nitrous Acid from twelve ounces of sugar of milk, *Scheele* obtained five drams of oxalic Acid in long crystals, and seven drams and a half of the ACID OF SUGAR OF MILK, in a white powder.

THE SACCHO-LACTIC ACID is combustible, and does not leave any ashes behind; it is sourish to the taste, and reddens litmus. It yields, by destructive distillation, a brown acid salt, smelling like the flowers of Benjamin, or acid of Amber. It is easily soluble in spirit, but not in water, and burns in the fire with a flame. It forms SACCHOLATES with the *Alkalis* and *Earths*; those with the earths being insoluble, and that with *ammoniac* having a sourish taste. On the metals it does not act, but with their calces it forms salts of very difficult solubility.

The serum of milk may, by several processes, be made to pass into the vinous fermentations. Six spoonfulls of alcohol, with three pints of milk, exposed in closed vessels for a month, giving vent occasionally to the gas, will be converted into good acetous acid. A spirituous liquor is also made from mares milk. Milk is turned, or its various constituent parts are separated spontaneously, or by the addition of rennett, and several other substances, such as neutral salts, acids, and even certain vegetables. The solid mass thus separated from the whey, contains two substances, *Cheese and Butter.*

CHEESE

CHEESE is formed by the curd undergoing a commencement of the putrid fermentation, by which it acquires consistency, taste, and colour; and is then pressed and dried for use. No substance has a stronger resemblance to cheese than boiled white of egg, both being soluble in diluted acid, in caustic alkali, and in lime water. The earth of cheese, according to *Scheele*, is a phosphate of lime. *Ammoniac* dissolves cheese more effectually than fixed alkalis, and *nitric Acid* disengages nitrogen from it.

BUTTER is procured from the cream which floats on the top of milk, by agitation, the remaining milk being termed BUTTER-MILK. Butter, unless salted, soon changes, becoming rancid like oils; the acid, thus developed, may be washed off by water, or by spirit of wine. With *fixed Alkali*, butter forms a soap. By distillation it yields water, a coloured concrete oil, and a strong pungent acid, the sebacic acid.

At Constantinople the butter is obtained from the Crimea and the Cuban, they do not sell it, but melt it over a slow fire, and scum off what rises; it will then preserve sweet a long time, if it was fresh when melted. *Eaton's survey of the Turkish empire.*

Milk appears to contain a fat oil, and a particular gluten, formed into a kind of animal emulsion, by means of a saccharine substance.

III. THE BLOOD is that red fluid which circulates in the animal body, by means of the arteries and veins; and supports life, by supplying all the or-

gans with the peculiar juices they demand. It varies in the same individual, not only with regard to the state of health, but as to the part it occupies. The blood, whilst circulating through the veins, differs in intensity of colour and degree of consistence, from that which is passing through the arteries. It putrifies by a gentle heat, and when slowly dried, effervesces with acids; if exposed to the air, it extracts humidity, and at the end of several months, yields a saline efflorescence ascertained by *Rouelle* to be soda.

The blood, when at rest, coagulates; and then separates into a yellow liquid, called SERUM, and a clot or COAGULUM. It may also be coagulated by alcohol and the acids, but alkalis render it more fluid.

THE SERUM has a greenish yellow colour, is of a slightly saline taste, turns syrup of violets green, and hardens in a moderate heat, which is the character of lymph: it easily putrifies, and then affords much carbonate of ammoniac. Distilled on a water bath, it yields an insipid phlegm, neither acid nor alkaline, but very readily putrifying; the residue being transparent like horn, and no longer soluble in water, but yielding, by farther distillation, an alkaline phlegm, carbonate of ammoniac, and a fetid blackish oil, more or less thick: the remaining coal is very voluminous and difficult to incinerate. The ashes afford muriate and carbonate of soda, and phosphate of lime. Being poured into boiling water, it directly coagu-

coagulates, a part communicates a milky colour to the water, and possesses, according to *Bucquet*, all the properties of milk.

Alkalis render it more fluid, and *Acids* coagulate it, a neutral salt being formed by the acid employed, and soda. The thickened serum affords nitrogen by the *nitric Acid*, assisted by a slight heat; if the fire be increased, nitrous gas is disengaged: the residue affords the oxalic, and a portion of the malic acid. *Alcohol* coagulates it, but the coagulum is soluble in water, unlike the coagulum formed by acids.

The COAGULUM, OR FIBROUS PART, of the blood, likewise contains much lymph, which may be carried off by washing. The colouring part, which contains much iron, may be carried off by the same process. The coagulum, when well washed, forms a fibrous white substance, void of smell, which distilled on the water bath, yields an insipid phlegm, easily susceptible of putrefaction. The residuum soon becomes dry, by a gentle heat; and if exposed to a considerable heat, it shrinks up like parchment; but distilled, it affords an alkaline phlegm, carbonate of ammoniac, oil, &c. The coal is less voluminous and lighter than that of lymph, and affords the phosphate of lime by incineration. The coagulum soon putrifies, and affords much ammoniac by distillation. The *Alkalis* do not dissolve it, and the *Acids* combine with it. The *nitric Acid* disengages much nitrogen, and afterwards dissolves it with effervescence, and the disengagement of nitrous gas. The

residue

residue affords oxalic Acid, and a small quantity of the malic Acid.

The blood contains much iron. The colouring matter of the blood being burned, and the coal lixiviated, an oxide of Iron is left, of a fine red colour, said to be obedient to the magnet.

The colour of the blood appears certainly to depend on the Iron it contains, but on considering the changes which take place during respiration, and the different colour of arterial and venal blood, it appears that the colour may be produced by the oxidation of the iron, during the passage of the blood through the lungs. The blood which has just circulated through every part of the animal, and has been brought back by the veins to the heart, is propelled into the lungs of a dark red colour, and impregnated with hydrogen and carbon. By inspiration the lungs are distended with air, the oxygen of which combines with the carbon, forming carbonic Acid; and with the hydrogen, forming water; another part of the oxygen unites with the blood, which returns from the lungs, and passes into the arteries of a bright red.

IV. FAT is a condensed inflammable animal juice, contained in its proper membrane. Its colour is usually white, but sometimes yellow; its taste insipid, and its consistence varying in different animals. It is obtained in a state of purity, by boiling in water, after being finely shred; it being thus separated from the membranes, fibres, &c. Fat much resembles oils;

oils; like them it is not miscible with water, forms soap with alkalis, and burns by the contact of an ignited substance.

Beef suet distilled on the water bath, affords oil and phlegm; the phlegm is reddish, has an acid taste, effervesces with alkalis, and turns the syrup of violets brown. *Marrow* yields the same products, and a substance of the consistence of butter.

SEBACIC ACID, or ACID OF FAT, thus obtained, has been concentrated by various processes by Mr. Crell. Alkalis, it is known, form a soap with animal fat; by heating this soap with a solution of alum, he separated the oil and obtained the SEBATE OF POTASH, by evaporation. The sulphuric Acid, afterwards distilled from this salt, decomposed it, and the sebacic Acid was separated.

This acid exists ready formed in the fat, since earths and alkalis disengage it.

Mr. Crell also obtained it by distillation from the butter of cocoa, and from spermaceti.

It seems to approach to the nature of the muriatic Acid, in some respects, but not in others. Mr. Crell thinks its place should be between the mineral and vegetable Acids. It forms a crystalizable salt with the *oxide of gold*, as it does likewise with that of *platina*. It unites with *Mercury* and with *Silver*, yielding the latter to the muriatic Acid, but not the former: it takes both from the sulphuric. It also takes *Lead* from the nitric and acetous Acids, and *Tin* from the nitro-muriatic. It attacks neither

Bis-

Bismuth, *Cobalt*, nor *Nickel*, nor decomposes the *sulphates of Copper*, *of Iron*, or *of Zinc*, nor the *nitrates of Arsenic*, *Manganese*, *Zinc*, &c. but reduces the *oxide of Arsenic*. It unites with the *carbonates of Lime* and *Alkali*, with effervescence, and forms salts very similar to the acetites of the same basis. Crell formed with it a SEBACIC ETHER.

The sebacic Acid treated with the *nitric Acid*, may be converted into the oxalic Acid.

From the foregoing analysis, it appears that fat is a kind of oil or butter, rendered concrete by an acid, being, in fact, an *acid Soap*. By still nicer analyses, it has been estimated, that six parts of fat consits of nearly five of carbon, and one of hydrogen, with some sebacic Acid: and not yielding so much oxygen and nitrogen as the fleshy parts.

Dr. Beddoes appears to think that fat is produced in the animal system, in proportion to the diminution of oxygen.

SPERMACETI is a concrete oil, extracted from a species of the whale, the *Cacholot*. It burns with a very white flame, and rises totally if distilled on a naked fire, assuming a reddish tinge, and losing its natural consistence by repeated distillations. The *Sulphuric* Acid dissolves it. The *Nitric* and *muriatic* have no action on it. *Alcohol* dissolves it by the assistance of heat, but lets it fall as it cools. It is also dissolved by *Ether*, and by the *fixed* and *volatile oils*.

V. THE

V. THE BILE is a fluid secreted by the liver, deposited in the gall-bladder, and thence conveyed into the duodenum. It is glutinous, of the fluidity of oil; of a very bitter taste, a green colour, inclining to yellow; and froths by agitation like a solution of soap. Distilled on a water bath, it yields a phlegm which is neither acid nor alkaline, but soon putrefies; this phlegm, and the bile itself, sometimes, it is said, emits a smell like that of musk. The residue of this distillation is a dry extract, which attracts the humidity of the atmosphere, and is tenacious, pitchy, and soluble in water. By more violent heat it yields ammoniac, an empyreumatic animal oil, concrete alkali, and inflammable air. The coal is not difficult of incineration, and contains iron, carbonate of soda, and phosphate of lime. Bile is decomposed by acids, by which a coagulum is separated, which is soluble in excess of acid, and which forms, with the muriatic Acid, a red solution; an oily substance, analogous to resin, also rises, and salts are formed which have soda for their basis. Bile is soluble in alcohol, by which the albuminous principle, which renders bile coagulable, and hastens its putrefaction, is also separated. The bile appears therefore to be a combination of soda with a matter of the nature of resins, and a lymphatic substance, which renders it susceptible of putrefaction and coagulation. It unites with oils, and cleans stuffs in the same manner as soap; but does not appear to

mix

mix with oily substances, in the same manner as soap.

When the bile becomes thick in the gall-bladder, it forms the concretions called *biliary calculi*, concreted, it is supposed, by the absorption of oxygen. These are soluble in general, in ardent spirit; and when the solution is left to itself for a certain time, brilliant and light particles are seen in it, which appear to have an analogy with the salt of Benzoin, and with those which are found in the human Calculi. There appear to be two sorts of biliary calculi, the one opake, consisting only of the condensed bile; the other composed of crystalline plates, similar to mica or talc, formed by the crystals just described.

VI. THE SOFT AND WHITE parts of animals. The membranes, tendons, cartilages, ligaments, and even the skin of animals contain a mucous substance, very soluble in water, but not in alcohol; known by the name of ANIMAL JELLY. It is obtained merely by boiling any of the foregoing substances in water: it has in general no smell, and is insipid to the taste. By distillation this jelly yields an insipid and inodorous phlegm, which easily putrefies; by a stronger heat it swells, becomes black, and emits a solid odour, with white acrid fumes: an alkaline phlegm, an empyreumatic oil, and a little carbonate of ammoniac passes over, and a spongy coal remains, difficult of incineration, and which contains muriate of soda and phosphate of lime.

As

As it putrifies, a large quantity of nitrogen, hydrogen, and carbonic acid gas, is emitted. It is dissolved by acids, but more readily by alkalis; and, with nitric Acid, nitrogen gas is disengaged. It seems to differ from the vegetable jelly, chiefly in the lymph it contains, which is evidently much more animalized than the other constituent parts of the jelly. If concentrated to such a degree as to give it the form of a cake, its disposition to putrefaction is stopped; on this principle dry or *portable soups* are formed. By a similar concentration of the jelly made from the parings of leather, the skins of animals, with the ears of oxen, calves, sheep, &c. are the strongest *glues* made. With the clippings of gloves and of parchment is made *size*, used by plaisterers, &c. *Gilders size* is made by boiling eel-skin with a small quantity of lime in water, to which some whites of eggs are added: that which is employed to fortify *paper*, and repair its defects, is made of wheat flour diffused in boiling water. From the mucilaginous parts of a large fish, in the Russian seas, is formed *Fish-glue* or *Isinglass*, which possesses very strong agglutinating powers, and is useful in stiffening, and giving a lustre to gauzes, &c. Isinglass forms a strong glue, by solution in either water or alcohol.

VII. THE MUSCULAR OR FLESHY PARTS afford by distillation, water, alkaline phlegm, empyreumatic oil, nitrogen gas, carbonate of ammoniac, and a coal which yields a small quantity of fixed alkali

and febrifuge salt. M. Thouvenel found, in flesh, a *mucous extractive substance*, soluble in water and in alcohol; and when concentrated, possessing an acrid and bitter taste. On hot coals it swells, liquifies, and emits a smell like that of burnt sugar: all its characters, indeed, show a resemblance between it and the saccharine matter of vegetables. M. Thouvenel also obtained, by a slow evaporation of the decoction of flesh, salt, in the form of down, and in crystals of an indeterminable figure: this salt appeared to him to be a phosphate of pot-ash in frugivorous, and a muriate of pot-ash in carnivorous, animals. Mr. Fourcroy thinks these salts may be phosphates of soda, or ammoniac, mixed with the phosphate of lime. The most abundant part of muscles, and that which constitutes their predominating character, is the *fibrous matter*. This is distinguished by its insolubility in water, and by its yielding more nitrogen gas, by the nitric Acid, than other animal substances. It also yields the oxalic and the malic Acid. It putrifies readily, when moistened; and affords much concrete ammoniac by distillation. The other matters contained in flesh, namely the lymph, jelly, and fat part, have been already spoken of.

M. Fourcroy found the muscular parts of bodies, which had been interred in the *Cemeterie des Innocens*, converted into a substance resembling spermaceti. *Annales de Chimie.* v.

Lord

Lord Bacon, in his *Sylva Sylvarum*, states, that such a change may be effected, by putting pieces of flesh into a glass covered with parchment and allowing the glass to stand six or seven hours in boiling water.

Thomas Sneyd, Esq. of Staffordshire, found in the mud, at the head of a fish pool, the body of a duck or young goose, converted into a hard fatty matter resembling spermaceti; having apparently suffered a similar change with that of the human bodies, observed by M. Fourcroy, in the *Cemeterie des Innocens*. *Phil. Trans.* 1792.

Mr. G. Smith Gibbes, having placed the leanest part of a rump of beef in a box with holes, so as to float on the side of a river, found, at the end of a month, it was converted to a mass of fatty matter. He also found a piece of lean mutton, on which nitrous acid had been poured, three days before, to be exactly the same with some which he had before got from the water, and which, though changed, was not so much so as the beef. *Phil. Trans.* 1794.

Mr. Gibbes further remarked, that the fatty matter formed from the flesh of quadrupeds, does not crystalize, whilst that from the human subject assumed a very regular, and beautiful crystaline appearance. To purify this matter, he exposed it to the sun and air, for a considerable time, reduced it to powder, and poured on it diluted nitrous Acid, this remaining on it an hour; he then washed it repeatedly, and finally melted it with hot water, and,

on allowing it to concrete, it was of a beautiful straw colour, and had the agreeable smell of the best spermaceti. *Phil. Trans.* 1795.

Dr. Crawford, by his ingenious experiments, discovered that *Cancerous matter* renders syrup of violets green, and that, with oil of vitriol, effervescence takes place, and the mixture becomes of a dark brown, a gas being disengaged, which has many of the properties of hepatic air, and which the Doctor called, *animal hepatic air.* This he found to be mixed, in the matter, with volatile alkali, forming an *hepatised ammonia*, which may occasion the black deposition from the solution of sublimate, when employed to wash venereal ulcers in the throat; on saturnine poultices applied to ill-conditioned ulcers; and on silver probes introduced into sinous ulcers. The animal fibres undergoing, in cancerous and other malignant ulcers, nearly the same changes which are produced by putrefaction, or destructive distillation.

Lean animal substances yield, by heat, alkaline air, carbonic Acid, and animal hepatic air, from which sometimes is deposited an oily empyreumatic substance; a diminution of the volume of the gas taking place. It seeming probable, the Doctor thought, that these three aërial fluids combining together, formed the oily empyreumatic substance.

The aërial fluids extricated from the muscular fibres of animals by putrefaction, consist of carbonic acid and animal hepatic gas, mixed with a very small pro-

proportion of phlogisticated air. From the green leaves of a cabbage, I obtained, the Doctor says, an aërial fluid, which, in most of its properties, resembled animal hepatic air. *Phil. Trans.* 1790.

VIII. URINE is an excrementitious fluid, secreted by the kidneys; in its natural state, it is transparent, of a peculiar smell, a citron yellow colour, and a saline taste. Besides the differences proceeding from peculiarity of habit, there are other differences in the urine, arising from other circumstances. That which is voided soon after copious drinking, is aqueous, having hardly colour or smell, and is called *crude Urine*, or *urina potus*, whereas that which is made after the sanguification, succeeding to a full meal, possesses all the characters of urine, and may be called the *Fæces Sanguinis*.

By the spontaneous decomposition of urine, it soon loses its original smell, and acquires that of ammoniac; which being also dissipitated, the smell becomes very fetid and offensive, and the colour brownish: in this state it manifests much less acid than when fresh. *(Halle)*. The crude urine presents very different phenomena, becoming soon covered with mouldiness, like the expressed juice of vegetables.

By distillation, the urine yields a phlegm which soon putrifies, and which affords ammoniac by its putrefaction. At the same time, a substance is precipitated of an earthy appearance, but which is, in reality, a peculiar saline substance. This salt

forms the sediment of urine, which separates by the cold, or by evaporation, even in the urine of persons in perfect health.

By evaporating urine to the consistence of a syrup, and allowing it to stand in a cool place, crystals are formed. This precipitate of crystals has been called *fusible Salt*, *native Salt*, and *microcosmic Salt*. To these crystals adhere the extractive principle, which exhibits, on distillation, the same result as animal substances and a saponaceous substance soluble in alcohol, crystalizable, difficult of drying, and yielding, by distillation, a small quantity of oil, carbonate and muriate of ammoniac, and leaving a residuum, which changes syrup of violets green.

The FUSIBLE SALT, or first precipitate of urine, is a mixture of all the salts contained in the urine, clogged with the extractive and saponaceous principle: to clear the salts from these, solution, filtration, and cooling in well closed vessels, must be had recourse to. *(Duc de Chaulnes)* Thus two strata of salt are obtained; the upper being composed of a salt, having the form of square tables, wherein tetrahedral prisms flattened, with dihedral summits are observed. *(Rouelle)* This is the phosphate of soda. Beneath this lies another salt crystalized, in regular tetrahedral prisms, and is the phosphate of ammoniac.

PHOSPHATE OF SODA was made known in 1740 by Haupt, who called it *Sal admirabile perlatum*. Heliot before him, and Pott, seventeen years after him,

him, took it for selenite. Margraaf fully described it in 1745, and Rouelle most accurately in 1776, under the name of *fusible Salt* with base of natrum.

Its crystals are flattened, irregular, tetrahedral prisms, with dihedral summits. With heat it fuses into a glass, which, by cooling, becomes opake. It is soluble in water, and turns syrup of violets green. The mineral Acids, and even distilled vinegar decompose it by seizing its Alkali; and Lime disengages its soda. Unlike the phosphate of ammoniac, it does not yield phosphorus with charcoal, not being decomposable by it.

Mr. Proust believed that the soda in this salt adhered not to the phosphoric Acid; but to a singular salt, with properties resembling those of the acid of borax, forming a salt which crystalizes in parallelograms, of an alkaline taste, effloresing in the air, swelling up, reddening and melting in the fire, assisting the vitrification of earths and forming a perfect glass with silex. But Klaproth has shewn that this salt of *Proust*, is merely the phosphate of soda; this is proved, by adding nitrate of Lime to a solution of this salt; the nitric Acid will be found to have united with soda, and the lime to be precipitated with phosphoric Acid. Again, if phosphoric Acid, obtained by slow combustion of phosphorus, be saturated with soda, slightly in excess, the fusible salt is formed; if this excess be taken up with vinegar, or if more phosphoric Acid be added, the salt described by *Proust* is formed.

PHOS-

PHOSPHATE OF AMMONIAC usually crystalizes in very compressed tetrahedral rhomboidal prisms, but the mixtures of the phosphate or muriate of soda cause an infinite modification of its forms. Its taste is urinous, bitter, and pungent. It is soluble in water, swells on the coals, emitting a strong smell of ammoniac, and melts by the blow pipe into a very fixed and fusible glass. It serves as a flux to the earths; in this case its alkali is disengaged and the phosphoric Acid unites with the earth. *(Chaptal).* *Bergman* proposed it as a flux. The fixed alkalis and lime water disengage the ammoniac. When heated with charcoal, phosphorus is produced.

PHOSPHORUS is thus obtained from *URINE*. Ten pounds of extract of urine of the consistence of honey, the muriate of lead, remaining after the distillation of four pounds of minium, two of muriate of ammoniate, and half a pound of charcoal are to be mixed together, and dried in an iron pot, untill reduced to a black powder, which is to be deprived of its volatile alkali, fetid oil, and muriate of ammoniac by distillation; the residue containing the phosphorus, which it will yield, by distillation in a good earthen retort. In this process the muriate of lead is employed to decompose the phosphate of soda, which is not decomposable by charcoal, and to form the phosphate of lead, which affords the phosphorus. *Margraaf.*

Phosphorus, in whatever manner made, is always one of the same substance; of a flesh colour, of the con-

consistence of wax, and at first transparent, but becoming white, and, in the sun, yellow. In the air it emits a white fume, and is luminous in the dark. Phosphorus is soluble in oils, more especially in volatile oils, which then become luminous: the oil of cloves is used for this purpose, and every time the bottle is opened a phosphoric flash emitting a small quantity of light is seen. A phosphoric gas may be extracted from phosphorus, which takes fire by the mere contact of air. Thus the nitric Acid being digested on phosphorus, a gas escapes, which takes fire in the receiver, affording the appearance of flashes of lightening striking through the cavity of the vessels. A very thin slice of phosphorus being placed on an anvil with a gros of the crystals of nitrate of silver, and smartly struck with a hammer, a most terrible detonation was produced, the edge of the hammer was turned up and the anvil shaken and marked with streaks of silver. The lapis infernalis and all the metallic nitrates being thus treated, violent detonations were produced. The experiment also succeeded with the common nitrate of pot-ash, but the hammer was required to be heated.

Brugnatelli.

Van Mons repeated these experiments with success and found the oxides of gold, silver, and mercury, by fire, to occupy the first rank among fulminating substances. He also discovered that two grains and a half of oxygenated muriate of ammoniac, with four grains of phosphorus, being gently crushed on the anvil,

anvil, a most terrible detonation ensued, which alarmed the house; and the concussion was so violent as to force the hammer out of his hand.

Annales de Chimie, 1797.

Girtanner conjectures phosphorus to be a compound of azote and hydrogen.

Phosphorus is not luminous in pure azotic gas, as was maintained by *Prof. Goëttling*; the presence of oxygen appearing to be necessary to produce this effect, *Jacqes*, *Heldibrand*, *Van Mons*. At about 100° of Fahrenheit, it takes fire with decrepitation, burns with a very bright flame, and emits a very abundant white fume, which is luminous in the dark. The residue of the combustion is a red caustic substance, which, attracting the humidity of the air, is dissolved into a liquor.

THE PHOSPHORIC ACID is the liquor remaining after this combustion of phosphorus has taken place, and is formed by the combination of oxygen with the phosphorus during the combustion. This acid thus obtained is impure, containing phosphorus not saturated with oxygen; but the phosphorus is more completely decomposed by the slower combustion, or combination with oxygen, which takes place at the common temperature of the atmosphere; the fluid Acid of phosphorus is thus obtained, without smell or colour, still however retaining a small quantity of undecomposed phosphorus, of which it may be cleared by digesting alcohol upon it.

By digesting *nitric Acid* upon phosphorus, nitrous gas

gas is separated and the oxygen unites to the phosphorus, forming phosphoric acid. If the acid is highly concentrated, the phosphorus burns at the surface. The water in which phosphorus is kept, contracts acidity in time, the water yielding its oxygen to the phosphorus.

Phosphorus precipitates some metallic oxides from their solutions, in a metallic state, and the phosphoric Acid is formed; the oxygen quitting the metal to unite with the phosphorus.—This acid, when pure, is clear, inodorous, and not corrosive; it may be concentrated to dryness, when its specific gravity, compared with water, is as 3. 1. It is very fixed. If after concentration it is put in a crucible, on hot coals, it boils, a green flame appears, and the mass is converted into a white transparent glass, insoluble in water.—It has no action on *Quartz*; but dissolves *Barytes* and *Clay*; and the latter with ebullition and great facility, forming a salt of sparing solubility, in the form of thin flattened needles, obliquely truncated at each end. It precipitates *Lime* from lime-water, and forms a true PHOSPHATE OF LIME, very similar to the basis of bones; and like that substance decomposable by the mineral Acids. Saturated with pot-ash it forms a very soluble salt, in tetrahedral crystals, terminating in tetrahedral pyramids. This PHOSPHATE OF POT-ASH is acid, swells on hot coals, is difficult of fusion and decomposable by lime-water.

From

From what has been said, it may be concluded that urine should be considered as water holding in solution matters purely extractive, with phosphoric, lithic or uric, and muriatic salts, having lime, ammoniac or soda for their basis.

From accurate experiments it appears that thirty six ounces of urine yields a residuum from an ounce to an ounce and a half, which consists of the following ingredients in nearly these relative proportions.

Muriatic Salts — — —	1 Dram	0 Grains
Phosphoric Salts — — —	3	50
Lithic or Uric Acid and phosphate of Lime, with excess of Acid.	0	25
Animal extractive matter	3	40

The salts are the muriates of pot-ash and of soda; the phosphates of Soda, of Lime, and of Ammoniac, with the lithic and phosphoric Acids. *Cruickshank.*

Urine, when first voided, contains an excess of phosphoric Acid, and thereby holds in solution more or less of phosphate of Lime. It soon runs into the putrefactive state, accompanied with the extrication of much ammoniac. The ammoniac is disengaged from urine, likewise, by the fixed alkalis and lime, which decompose the phosphate of ammoniac; and acids diminish its odour, by combining with and fixing the ammoniac which is the principle cause of its odour. The urine of animals which feed on vegetables does not appear to contain phosphoric Acid, but an acid of a vegetable nature, which seems to resemble the Benzoic. *Rouelle and Fourcroy.*

Besides

Besides phosphorus and the various combinations of its acid, *Fourcroy* and *Vauquelin* have ascertained that the base of Alum, and the phosphate of Magnesia, with a certain *peculiar* animal matter, exists in Urine. But their investigations are only so far advanced as to show the likelihood of their terminating in most useful discoveries.

Human urine contains ten constant ingredients; muriate of Soda, muriate of Ammoniac, acid phosphate of Lime, phosphate of Magnesia, phosphate of Soda, phosphate of Ammoniac, Uric Acid, Benzoic Acid, Jelly, Albumine, and the specific matter of Urine, called Urée, to which matter the Urine owes its property of becoming, by spontaneous fermentations, a fluid so different from what it is when first voided, as to contain nine new ingredients.

IX. THE CALCULUS OF THE BLADDER is chiefly formed of a peculiar concrete acid, which is slightly soluble in boiling water, and is deposited in crystals, as the solution cools. It has been ascertained that the Calculus 1st. Is dissolved by the *sulphuric Acid*, with heat. 2. Is not acted on by the *muriatic Acid*. 3. Is dissolved by the *nitric Acid*, with effervescence and the disengagement of the nitrous gas and carbonic Acid: the solution is red, contains a disengaged acid, tinges the skin of a red colour, and is not precipitated by the muriate of barytes, nor rendered turbid by the oxalic Acid. 4. Is not acted on by the *carbonate of Pot-ash*, but is dissolved by the *caustic Alkali*, as well as the *volatile*

Alkali. 5. Is dissolved in *Lime-water* in the quantity of 5, 37 in 1000 grains, and may be precipitated by acids. 6. Contains a small quantity of *Ammoniac*. 7. The coaly residuum of combustion indicates an animal substance of the nature of jelly. *(Scheele)*.

This illustrious chemist has also proved that all Urine, even that of infants, holds a small quantity of the matter of calculus in solution, and that the brick coloured deposition from the Urine in fevers, is of the nature of calculi, but he did not find that it contained a particle of calcareous earth. By pouring the sulphuric Acid into the nitrous solution of the calculus, a true sulphate of lime was obtained; although the lime did not exceed the 200th part of the entire weight.

This chemist also detected a white spongy substance, not soluble in water, spirit of wine, acids, or alkalis, nor in the nitric Acid, even in the state of ashes; but the quantity was too small to be thoroughly examined.—The calculus therefore is not analagous to bones in its nature; neither is it a phosphate; but Mr. *Chaptal* says, that by decomposing calculi, by the caustic alkali, he has precipitated lime, and formed phosphates of pot-ash. Some physicians have thought that the arthritic concretions were of the same nature as the calculus, but several experiments appear to militate against this opinion, especially those which prove that the arthritic concretions are soluble in the syocovia, and easily

easily mix with oil and water, which the calculus does not. *(Watson).*

THE URIC ACID, or *acid of Calculi*, formerly called the *lithic Acid*, is concrete, sparingly soluble in water, and is decomposed, and partly sublimed by distillation: it decomposes the *nitric Acid*, unites with *Earths, Alkalis and metallic Oxides*, and yields its bases to the weakest *vegetable Acids*, not excepting the *Carbonic*.

Mr. *Lane* ascertained by careful experiments that there exists a great difference in different calculi, some being dissolved in the lixivium saponarium, and others being scarcely altered; some retaining their form, whilst others were nearly evaporated by a red heat. Different parts of the same calculus varying considerably in these respects.

Phil. Trans. 1791.

The matter obtained from calculi, by solution in lye of caustic fixed alkali, and precipitation by acids, has been supposed to be an acid similar to that obtained by sublimation, and which has been termed LITHIC ACID. Dr. *Pearson* obtained the foregoing precipitate, in the proportion of at least one half of the matter of the calculi; and ascertained that this precipitate does not belong to the genus of acids; that it is not the same thing as the *sublimate of Scheele*, nor is to be referred to the animal mucilages, but that it belongs to the genus of *animal oxides*. Its peculiar and specific distinguishing properties being imputresibility, facility of crystalliza-

tion, insolubility in cold water, and that most remarkable property of all others, of producing a *pink* or *red matter*, on evaporation of its solution in nitric Acid. Of 300 grains of calculus 175 were this peculiar *animal oxide*, 96 were *phosphate of Lime*, 29 were *ammoniac* and probably united with it, *phosphoric Acid*, *Water*, and *common mucilage of urine*.

The term *lithic*, being, the Doctor says, a gross solecism, he proposes, as more appropriate, the term OURIC or URIC. This oxide he would therefore term the URIC OXIDE.

From 100 grains of an urinary concretion he obtained only 18 grains of the acid sublimate of *Scheele*, and doubts whether the lithic Acid of *Scheele* exists as a constituent of urinary concretions, or is compounded, in consequence of a new arrangement of the elementary matters of the concretion, by the agency of fire. The Doctor did not find the uric oxide in the urinary concretions of any phytivorous animal. *Phil. Trans.* 1797.

Fourcroy asserts that *Scheele* did not give the name of lithic Acid to the sublimate of the calculus, as Dr. *Pearson* asserts, and that the peculiar animal oxide of Dr. *Pearson* is really *Scheele's* acid, (the lithic Acid). *Fourcroy* approves of the adoption of the name *ouric Acid*, especially as Dr. *Pearson* has found the same acid in arthritic concretions, and it has not yet been found, but in man.

Annales de Chimie, XXVII.

Dr.

Dr. *Pearson* found the uric acid in *arthritic* concretions.—Mr. *Tennant* discovered in them a combination of that acid and Soda. *Fourcroy* and *Vauquelin* confirm this analysis, finding them to consist of *urate* of Soda, with a considerable quantity of animal matter.

X. THE PRUSSIC ACID is produced by exposing the horns, hoofs, or dried blood of animals, with an equal quantity of fixed Alkali to a red heat. The Alkali is found to be neutralized, by the acid thus formed, and on evaporation, will yield a salt in tetrahedral crystals, which is then called PRUSSIATE OF POT-ASH, or of SODA, according to which Alkali has been employed. These prussitates of Alkali precipitate all *metals* from their solution; the alkali uniting with the acid which holds the metal in solution, whilst the Prussic acid unites with the metallic oxide, and communicates to it a peculiar colour. Thus *gold* is precipitated of a *yellow*; *lead* of a white; *copper* of a *brownish red*, and *iron*, of a *dark blue*, being a PRUSSIATE OF IRON, or the substance called *Prussian-blue*.

From this substance the Prussic acid may be again separated, by digestion with pure alkali, the prussiate of alkali, being again formed, and the iron left in a brown oxide.

The Prussic acid is obtained in a pure state, by supersaturating the Prussiate of alkali with sulphuric acid, and by subsequent distillation. It may also be obtained by distillation of blood with

nitric acid. It has an acid taste and suffocating smell; but except its capacity of combining with alkalis and metals, it manifests no conspicuous acid properties.

By digestion of Prussiate of Iron with Ammoniac, the PRUSSIATE OF AMMONIAC is obtained, and, in the same manner, is PRUSSIATE OF LIME obtained with Lime Water. This acid is found also in the mineral kingdom, combined with Iron; it also exists in vegetables. The Prussic colouring principle has been obtained by passing Ammoniacal Gas through Charcoal. *Clouet.*

Proust describes Prussian Blue to be an Oxide, whose basis contains 48-100 of oxygen. Berthollet believes its basis to be composed of Hydrogen, Nitrogen, and Carbon: but its constituent parts are not yet known.

XI. THE ZOONIC ACID is a new acid discovered by *Berthollet*. The fluid obtained by distillation from animal substances, has been hitherto thought to contain no other principle than carbonate of ammoniac and an oil. Berthollet has ascertained that it contains an acid, which he names Zoonic Acid. He has obtained it from bones, woollen rags, &c. also from the gluten of wheat, and the yeast of beer. To obtain it, after separating the oil from the liquor yielded by the destructive distillation, he adds lime to this liquor, then separates the carbonate of ammoniac by a boiling heat, and adds more lime; thus obtaining the ZOONATE OF LIME. By distilling a mixture

mixture of Phosphoric Acid with the Zoonate of Lime, he obtains the pure Zoonic Acid.

The Zoonic Acid smells like meat which has been roasted; a process, in which indeed it is formed. It is of an austere taste, reddens turnsole, and effervesces with alkaline carbonates. It has a stronger attraction to the oxides of mercury and lead, respectively, than the acetous and nitric acids. The ZOONATE OF POT-ASH calcined does not form a Prussiate of iron, with a solution of that metal.

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Tromsdorff thinks this Acid of *Berthollet*, which he imagined to partake of both an animal and vegetable nature, is analogous to the Sebacic Acid.

XII. THE FORMIC ACID, or the *Acid of Ants* exists in so disengaged a state, that the transpiration of these animals, and their simple contact proves its existence. The large red ant furnishes the greatest quantity, and seems to be most replete with it in the months of June and July, when its merely passing over blue paper, is sufficient to turn it red. This acid may be obtained by simple distillation, only mixed with a small quantity of empyreumatic oil, from which it may be separated by a funnel. Its specific gravity being to that of water, as 1,0075 to 1,0000; when exceedingly pure, it is as 1,0453 to 1. It may also be obtained by lixiviation, washing the ants first in cold, and then in boiling water, until all the acid is procured. It may likewise be obtained in a FORMIATE OF POT-ASH, or of SODA, by

placing

placing linen cloths impregnated with an alkali in an anthill. It affects the nose and eyes in a peculiar, but not dissagreeable manner. When pure, its taste is burning and penetrating; but agreeable, when diluted with water. It possesses all the characters of acids. When boiled with *Sulphuric Acid* the mixture blackens, white penetrating vapours arise, and a gas is disengaged, which unites difficultly with distilled water, or lime water; the formic acid is hereby decomposed, for it is obtained in less quantity. The *Nitric Acid* distilled from it destroys it completely; a gas arising which renders Lime-water turbid, and is difficultly and sparingly soluble in water. The *Muriatic* only mixes with it, but the *Oxy-muriatic Acid* decomposes it. It unites perfectly with *spirit of wine*, but difficultly, even with heat, with the *fixed* or *volatile oils*. The order of its affinities seems to be Barytes, Pot-ash, Soda, Lime, Magnesia, Ammoniac, Zinc, Manganese, Iron, Lead, Tin, Cobalt, Copper, Nickel, Bismuth, Silver, Alumine, Essential Oils, Water. *(Ardvidson and Ocihn)* An acid may likewise be obtained from the *Millepedes*, *(Lister)*—From the fluid ejected by the *great forked tail Caterpillar of the willow*. *(Bonnet)*—From *grasshoppers*, the *may-bug*, the *lampyris*, and *silk-worm*. The acid is extracted by digesting the subject of experiment in Alcohol, which dissolves the acid, and precipitates the foreign animal matters.

XIII. THE BOMBIC ACID is found to exist in all the states of the silk worm, in all its stages of existence

even in the eggs; but in the egg and in the worm, it is combined with a gummy glutinous substance. (*Chaussier*).

XIV. HARTSHORN gives name to several products used in medicine, which though the preference is given to this horn, may be obtained from any other. By distillation an alkaline phlegm is first procured, which is called the *volatile spirit of Hartshorn*; a reddish oil next comes over, more or less empyreumatic, this rectified, is the *animal oil of Dipple*; then rises a considerable quantity of the *carbonate of Ammoniac*, coloured by the oil, but from which it may be purified to a beautiful degree of whiteness. The coaly residuum contains soda, with sulphate and phosphate of Lime, from the latter of which phosphorus may be obtainedr: Burnt entirely to an ash, it is the *calcined Hartshorn* of the shops.

XV. BONES consist chiefly of jelly, fat, and an earthy neutral salt. By distillation they yield hydrogen and carbonic acid gas, a volatile alkaline liquid, an empyreumatic oil and dry mild ammoniac, the residuum is a coal.

The earth of calcined bones was discovered in 1769, to consist of lime united with the acid of urine. (*Gahn.*) It was then discovered, that by decomposing this salt of bones by the nitric and sulphuric Acids, evaporating the residue, which contains the phosphoric Acid in a disengaged state, and distilling the extract with powder of charcoal, phosphorus was obtained. (*Scheele*).

Pulverized

Pulverized burnt bones are to be mixed with half their weight of sulphuric Acid, and after digesting two or three days, water must be added and the mixture digested still farther on the fire. The water of the lixivium, as well as the water with which the residuum is washed, to deprive it of its salts, is then to be evaporated in vessels of stone ware, until it affords an extract, which must then be dissolved in the least possible quantity of water, and filtered, that the sulphate of lime may be separated. This extract may be then put in a large crucible, and the fire urged; when it swells up, but at last settles, and at that instant, a *white glass*, of a milky hue is formed,* which mixed with an equal quantity of charcoal, and distilled in a porcelain well coated retort, yields the phosphorus by distillation.

The theory of this operation may be thus explained. The phosphoric Acid contained in the fusible salt, is displaced by the sulphuric Acid, which forms with the calcareous earth, a large quantity of sulphate of Lime. By the succeeding operations, the acid, which is still combined with other animal substances, is concentrated, and by the distillation with charcoal, the phosphoric acid is decomposed; its oxygen unites with the coal, and affords carbonic acid, while the phosphorus itself is disengaged. The phosphorus may

* Becher, who was acquainted with this glass of bones, says, "*homo vitrum est, et in vitrum redigi potest.* A skeleton of nineteen pounds, yields five pounds of phosphoric glass.

may be purified, by being immersed in a vessel of boiling water; as the phosphorus melts, and may be passed through a piece of chamois leather like mercury. The lower orifice of a funnel being stopped, phosphorus with water is to be put in it, and the funnel plunged in boiling water; as the heat is communicated the phosphorus melts, runs into the neck of the funnel, and takes that form; when cold it is to be thrust out of its mould, and kept under water.

XVI. ENAMEL OF TEETH being dissolved without heat in muriatic Acid, selenite was precipitated by the addition of sulphuric Acid, after which the remaining fluid was rendered thick and viscid by evaporation. This when diluted with water, precipitated lime from lime-water, in the state of phosphate. Acetite of lead being added to another portion, a white matter was precipitated, producing a light, and smell on burning charcoal, like phosphorus, and soluble in nitrous acid, whereby it was distinguished from muriate or sulphate of lead. Enamel being also dissolved in nitric Acid, the solution was saturated with carbonate of Ammoniac, by which a precipitate was formed composed of Lime combined with a portion of phosphoric Acid, and phosphoric Acid was also precipitated from the remaining fluid, by solution of acetite of Lead. The Enamel is therefore not a carbonate, but a phosphate of Lime. Lime and phosphoric Acid appearing to be the essentially constituent principles of *enamel*, of the substance of *teeth* formed on pulps, and of common bone.

XVII. SHELLS

XVII. SHELLS, as to the substance of which they are composed, are *porcellaneous* with an enamelled surface, and when broken, are often of a fibrous texture; or are composed of *Nacre* or *Mother of Pearl*. It appears that the porcellaneous shells are composed of carbonate of Lime, cemented by a very small portion of gluten; and that mother of pearl and pearl do not differ from these, except by a smaller proportion of carbonate of Lime; which instead of being simply cemented by animal gluten, is intermixed with, and serves to harden, a membranaceous or cartilaginous substance; and this substance even when deprived of the carbonate of Lime, still retains the figure of the shell. These shells appear to be formed of various membranes applied *stratum super stratum*, each membrane having a corresponding coat, or crust of carbonate of Lime. The inhabitants of these stratified shells increase their habitation by new strata, each stratum exceeding in extent those which were previously formed, the shell becoming stronger in proportion as it is enlarged, and its number of strata denoting its age.

Tooth and bone being steeped in Acids, the ossifying substances are dissolved, and a cartilage or membrane of the figure of the bone remains. In this, as well as in the effects from exposure to fire, a great similarity will be found between these substances and shells composed of Nacre and Mother of Pearl. Porcellaneous shells also resemble enamel, not only in the results from their exposure to fire, but in suf-

fering

fering a complete dissolution in Acids, and not leaving any pulpy or cartilaginous matter.

THE CUTTLE BONE of the Shops, appears in composition exactly to resemble shell, it consisting of various membranes, hardened by carbonate of Lime, without the smallest mixture of phosphate.

THE CRUST OF THE ECHINUS approaches most nearly to the shells of the eggs of birds, consisting of carbonate, with a small proportion of phosphate of Lime, cemented by gluten.

THE ASTERIAS RUBENS manifested a portion of carbonate of Lime, without any mixture of phosphate, but in the ASTERIAS PAPPOSA a small quantity of phosphate of Lime was discovered. In the *crustaceous covering of marine animals*, such as the *crab, lobster, prawn and cray-fish*, carbonate and phosphate of Lime, but the former in the largest proportion, were found. Phosphate of Lime mingled with the carbonate, appearing to be the chemical characteristic which distinguishes the crustaceous from the testaceous substances. The presence of phosphate of Lime in the former evincing an approximation to the nature of bone, which consists principally, as far as the ossifying substance is concerned, of phosphate of Lime, accompanied by a small proportion of some saline substances, and by sulphate of Lime. By these ingenious investigations, carbonate of Lime was also discovered to enter into the composition of bones; but as the carbonate exceeds in quantity the phosphate of Lime, in egg-

shells and crustaceous animals, so in bones it is *vice versa*. It is possible that, shells containing only carbonate of Lime, and bones containing only phosphate of Lime, will form the two extremities of the chain. Bones of fish appear to contain more of the cartilaginous substance, and less of the phosphate of Lime, than is commonly found in the bones of quadrupeds.

XVIII. SYNOVIA in a healthy state, appears to possess phosphate of Lime, though but in small quantity, 480 grains, not yielding more than one grain. It can therefore hardly be considered as one of its constituent principles. This may be also observed of *Cartilage*, and of such *Horns* as are distinctly separate from bone, as are those of the ox, the ram, chamois, also tortoise-shell; 500 grains of the horns of an ox yielding only 1, 50 grains of residuum, less than half of which was phosphate of Lime. *Buck's or Stag's horn*, has every chemical character of bone, with some excess of cartilage. By experiment on dry hog's BLADDER, it appears that phosphate of Lime is not an essential ingredient of membrane.

The *Bones of the Gibraltar rock* consist principally of phosphate of Lime; and the cavities have been partly filled by the carbonate of Lime, which cements them together. Fossil bones resemble bones which by combustion, have been deprived of their cartilaginous part, retaining the figure of the original bone, without being bone in reality, as one of the most essential parts have been taken away.

The

The destruction or decomposition of the cartilaginous parts of teeth and bones in a fossil state, must have been the work of a very long period of time, unless accelerated by the action of some mineral principle; for after steeping in muriatic Acid, the os humeri of a man, brought from Hythe, in Kent, and said to be taken from a Saxon tomb, the remaining cartilage was found nearly as compleat as that of a recent bone. Mr. H. questions, if bodies consisting of phosphate of Lime, like bones, have concurred materially to form strata of Limestone or chalk; for it appears to be improbable that phosphate is converted into carbonate of Lime, after these bodies have become extraneou fossils. *Glossopetræ* also yielded phosphate and carbonate of Lime, the latter appearing to be derived from the calcareous strata which had inclosed them, and which had taken the place of the decomposed cartilage.

Mr. Hatchett, Phil. Trans. 1799.

XIX. THE EGGS OF BIRDS consist of an osseous covering called the shell, a membrane, the albumen or the white, and the yolk. The shell, like bones, contains a gelatinous principle, with the carbonate and the phosphate of Lime. The white is of the same nature as the serum of blood; heat coagulates it, so do acids and alcohol. By distillation it affords a phlegm, which easily putrefies, then carbonate of ammoniac and empyreumatic oil came over, a coal remaining in the retort which yields soda and phosphate of Lime. Sulphur has also been said to have

been obtained from it by sublimation. *(Deyeux)*. The yolk of eggs also contains a lymphatic substance, mixed with a certain quantity of mild oil, which on account of this mixture is soluble in water.

XX. Tears are secreted by the lachrymal glands, and are chiefly composed of a peculiar kind of mucilage, common salt, phosphate of Lime, phosphate of soda, and soda in a free and apparently caustic state. *Jacquin.*

XXI. Mucus of the Schneiderian membrane. At its first secretion is analagous to the tears, but changes by remaining in the nose, probably from the oxygen it imbibes from the inspired air, and the carbonic Acid of the expired air, saturating the free soda.

XXII. Saliva is secreted by its appropriate glands in the neighbourhood of the mouth; it does not appear to differ in its constituent parts from mucus, except in containing a greater quantity of water.

XXIII. Pus is secreted from vessels which are under the influence of some morbid change. It appears by its analysis to differ very little in its constituent parts from mucus: it is, however, said to undergo the acid fermentation, while the former becomes putrid. *(Salmuth)*. Mixed with an equal quantity of a saturated solution of carbonated pot-ash; pus, it is said, will disengage a transparent tenacious jelly, but mucus will not.

XXIV. Semen, its constituent parts appear to be water, animal mucilage, soda, and phosphate of Lime, it

it has a peculiar smell and acrid taste, and changes violets green. When fresh, it is quite insoluble in water, but afterwards combines easily with it. After its discharge it becomes more opaque and consistent, but in a few hours it becomes even more clear and fluid than before, and in a few days deposits rhomboidal and foliated crystals of phosphate of Lime.

XXV. SWEAT. Its smell and taste varies much in different subjects; in general, it changes blue vegetable juices red; this property is said to be chiefly possessed by the sweat of gouty persons, and to be occasioned by the presence of phosphoric Acid.

XXVI. The HAIR, WOOL, and BRISTLES of animals differ both from the bones and white animal soft parts, containing less jelly, fat, and lymph.

XXVII. FEATHERS appear to differ chiefly, chemically considered, from the foregoing substances in containing a still smaller proportion of fat and jelly. The quills, however, approach more to the nature of horn.

XXVIII. SILK, and the web of other caterpillars much resemble wool in their chemical properties. *Welter* treated silk with the nitric Acid, to obtain oxalic Acid: when obtained he returned it with some water and the contents of the receiver into the retort, and by several distillations procured a *silky salt* of a golden yellow colour, which acted as gunpowder on the contact of an ignited body. Its crystals are octahedrons and of a bitter taste. He also found, in animal substances, another peculiar kind of matter colour-

less, soluble in concentrated nitric Acid and precipitable by water. *Phil. Journal, Sep.* 1799.

From Bulletin de la Soc. Philomatique.

Count *Rumford* in 1786 pointed out the relative conducting powers of heat in various bodies, of very different natures, both solid and fluid, and in the year 1792 in pursuing similar experiments, he was led to conclude, that, though the particles of air individually, are capable of receiving and *transporting* heat, yet air in a quiescent state is not capable of conducting it; in short that heat is incapable of *passing through a mass of air*, penetrating from one particle of it to another. Hence may the increase of the non-conducting power of the air, when mixed with any very fine light, solid substance, as *fur*, *eider-down*, &c. loosely enveloping any body be accounted for; since though they might not hinder the air from giving a passage to the heat, had it been capable of passing through it, yet they might very much impede it in the operation of transporting it. But besides he observes, in *furs*, for instance, the attraction between the particles of air, and the *fine hair* in which it is concealed, being greater than the increased elasticity, or repulsion of those particles with regard to each other, arising from the heat communicated to them by the animal body, the air in the fur though heated, is not easily displaced; and this coat of confined air is the real barrier which defends the animal body from the external cold. Hence the preservation

servation of the warmth of animals, by furs, feathers, &c. and of the earth, by snow.

Philos. Transactions.

XXIX. CANTHARIDES are insects which applied, in fine powder to the epidemic, cause blisters and excite heat in the urine with strangury. They produce the same effects on the urinary passage, taken internally in small doses. Water extracts from them a reddish yellow bitter extract, and a yellowish oily matter; and Ether takes up a green, very acrid oil, in which the virtues of the Cantharides most eminently reside. To form a tincture, which unites all the properties of the Cantharides, equal parts of alkohol and water must be employed: if spirit of wine alone be used, it takes up only the caustic part.

XXX. MILLEPEDES, *aselli, porcelli, woodlice.* These yield, by distillation, an insipid or alkaline phlegm, the residue affording an extractive matter, an oily waxy substance, soluble in spirt of wine only, and a muriate, with an earthy and an alkaline base.

XXXI. COCHENILLE. These insects are more especially used in dying; their colour takes readily, upon wool: the most suitable mordant is the muriate of tin.

XXXII. AMBERGRIS, is a light ash-coloured body, chiefly found on the sea-shores in the East Indies. It yields a grateful smell, softens with heat, and affords, by distillation, an acid and an oil, very similar to that of amber.

Ambergris has been found in the intestines of a whale, and has been also expelled by the fundament.

It

It is found most commonly in sickly fish, and is supposed to be the cause or effect of disease.

Examination of Mr. Champion before the Lords Commissioners, &c. Whitehall.

Philos. Transactions, 1791.

XXXIII. LAC, or GUM LAC, is a kind of wax collected by red-winged ants from flowers in the East Indies, which they transport to the small branches of the tree where they make their nests. The Hindoos have six names for Lac; but they generally call it Lácshà, from the multitude of small insects, which, as they believe, discharge it from their stomachs on the tree, on which they form their colonies. The Lácshà, or Lac insect, is a genus in the class of Hemiptera. The *Chermes Lacca* is always found on the branches of the *Mimosa Glauca*, or *Mimosa Cinerea*, or on a new species called by the Gentoos *Conda Corinda*. *Dr. W. Roxburgh, Phil. Trans.* 1790.

OF ANIMAL PUTREFACTION,

EVERY animal body, when deprived of life, suffers a gradual decomposition or resolution, which is effected chiefly by the access of air, aided by a due degree of moisture and of heat. Its colour first becomes pale; its consistence diminishes, its texture is relaxed, and a faint and disagreeable smell is emitted. The colour at this time changes to blue and

and green, the parts become more and more softened, the smell becomes fetid, and the colour of an obscure brown. The fibres now yield, the texture is more resolved, the putrid and nauseous smell is mixed with a smell of a more penetrating kind, arising from the disengagement of ammoniacal gas; after this the mass becomes of still less and less consistence, and the smell becomes more faint and nauseous, and the effluvia exceedingly active and injurious, arising, it has been said, from the separation of phosphorated and carbonated hydrogen gas. When it has continued in this state some time, the mass again swells up, and carbonic acid gas is separated; this part of the process is protracted for some time, when it changes into a soft putrid mass, which dries at last into a dark brown pliable earth.

ADDENDA.

MR. RAFN, of Copenhagen, has ascertained that CARBON, either vegetable or animal, has a decided influence in the nourishment of vegetables. The Carbonic Acid appears by his experiments to produce exactly the same effect as charcoal of wood.

THE ACID OF CHROME, until now only found in the ruby, the emerald, and the red-lead of Siberia, has been found in France, combined with *iron*, forming a CHROMATE OF IRON.

Guyton

Guyton has obtained, by a three-blast furnace, with a heat about 183°. Wedgwood, a well-formed button of TUNGSTEN.

FLUATE OF ARGILL has been found in Greenland.

As the GALLIC ACID does not seem to combine with the matter of skin, and as its astringency will corrugate the surface, we may conclude, I think, that its presence in *tanning* is not only useless, but detrimental. *Mr. Biggin, Phil. Trans.*

Proust has discovered Mercury in the *Muriatic Acid*, in the state of Corrosive Sublimate, arising from Mercury which is naturally contained in Sea-Salt. *Journal de Physique.*

A substance of a metallic appearance, resembling a metallic leaf, or metallic needles, was obtained by sublimating INDIGO *per se*, or with *phosphorus*, *sulphur of pot-ash*, &c. This substance was not acted on by the magnet, was a little brightened by muriatic Acid, and not at all acted on by the alkalis, or by alcohol, or by the sulphuric Acid, but was rapidly dissolved by the nitrous Acid; the solution yielding a white precipitate with alkalis.

This substance, of metallic appearance, is probably an universal principle in nature, that may occasion those golden and silvery hues on many insects.

By repeatedly distilling nitrous Acid from Indigo, a fluid was also obtained, seeming to possess the properties of Laurel-water.

INDIGO, this writer thinks, consists of a peculiar volatile

volatile matter, *sui generis*, capable of becoming blue by a small portion of oxygen, combined with a resinous or bituminous substance, convertible by the nitrous Acid into laurel oil and gaseous products.

Correspondent in Nicholson's Journal, Feb 1800.

Mr. Davy, in a letter to Mr. Nicholson, describes the *Gaseous Oxide of Azote*, or as he prefers to call it, NITROUS OXIDE, mentioned in the former part of this work, to have been produced by the exposure of *Nitrate of Ammoniac*, perfectly neutralised, and rendered as dry as possible, to a heat not below 310°. or above 400°. of Fahr. It being then decompounded into water, gaseous oxide, and this particular gas *. It is likewise obtained by exposing *nitrous gas* to dry *sulphate of pot-ash*. To render this gas sufficiently pure for respiration, it must be passed through water, and suffered to remain in contact with it at least an hour and a half. When respired, it in general produces an extraordinary degree of exhilaration.

From the occurrence of certain facts, Mr. Davy desires to be considered as a Sceptic, with regard to his own particular Theory of the Combinations of LIGHT and Theories of Light in general. He therefore now adopts the common Nomenclature.

CARBONATE OF AMMONIA, he has discovered, changes in its composition with every change of its temperature, giving out carbonic Acid when heated,

* This decomposition was discovered by the illustrious *Berthollet*.

and

and absorbing it again as it cools: when passed through a tube heated red, it is decompounded into water, charcoal, nitrogen, and hydro-carbonate.—SULPHATE OF AMMONIA, thus heated, he found was decompounded into sulphur, water, and nitrogen. *Nicholson's Phil. Journal, Feb.* 1800.

Guyton has obtained unequivocal proofs, not only that there exists among THE EARTHS a tendency to unite in the humid way, but also that with regard to some of the earths, the union is such as to be capable of resisting an addition of Acid in excess.

Guyton also observes, that the action which BARYTES STRONTIAN and LIME exert on oils, soaps, and animal matters, their union with the Prussian colouring principle, sulphur, and the Acids, form so many new points of resemblance with the alkaline substances. But he does not seem to think they are sufficient to warrant a common classical denomination. *Annales de Chimie*, XXXI.

TABLE OF PRECIPITATIONS, apparently by SINGLE ELECTIVE ATTRACTIONS, from *Bergman*, with alterations and additions,

By George Pearson, M. D. F. R. S.

1 CALORIFIC. *In Water.*	2 OXYGEN. *In Water.*		*In Fire.*		3 SULPHUR. *In Water.*	
Oxygen	Basis of Muriatic, and various other Acids	Platina	Carbon	Q. Silver, at 600°.	Oxygen	
Æther		Q. Silver	Zinc	Arsenic	Molybd Ox. and Acid	
Alcohol		Gold	Iron	Sugar	Ox. of Lead	
Vol. Alkali	Carbon	Nitrous Gas	Hydrogen	Sulphur	——Tin	
Water	Phosphorus	Muriatic Acid	Metal-Mang.	Calorific	——Silver	
Vol. Oils	Sulphur	Nitrous A.	Cobalt	Gold	——Q. Silver	
Glass	Light ?	Sulphuric A.	Nickel	Silver	——Arsenic	
Q. Silver	Zinc	Manganese Ox. white	Lead	Platina	——Antimony	
	Copper	Hydrogen	Tin	Q. Silver, at above 1000°.	——Iron	
	Lead		Phosphorus	Manganese Ox. white	Fixed Alkalis	
	Iron	Vol. Oils	Copper		Baryt	
Bases of all Gases	Silver	Alcohol	Bismuth		Strontia	
		Water	Antimony		Lime	
					Magnesia	

Phos-

Phosphorus
Fat Oil
Vol. Alkali
Æther
Hydrogen G. ?

In Fire.

Fixed Alkali
Oxygen
Iron
Copper
Tin
Lead
Silver
Cobalt ?
Nickel ?
Bismuth
Antimony
Q. Silver
Arsenic
Uranite ?
Molybdena
Sylvanite

4
SALINE SULPHURETS.
In Water.

Oxygen

Ox. of Gold
Silver
Q. Silver
Arsenic
Antimony
Bismuth
Copper
Tin
Lead
Nickel
Cobalt
Manganese
Iron
Other Oxides
Carbon

Water
Alcohol
Æther ?

In Fire.

Manganese
Iron

Copper
Tin
Lead

Silver
Gold ?
Antimony ?
Cobalt
Nickel
Bismuth
Q. Silver ?
Arsenic ?
Carbon

5
SILICA.
In Water.

Fluor A.
Fixed Alkali
Baryt ?
Strontia ?

6
ARGILL.
In Water.

Sulphuric
Nitric
Muriatic

Fluoric
Arsenic
Oxalic
Tartareous
Phosphoric

Acetous and other Acids

Alkalies

Baryt ?
Strontia ?

In Fire.

Phosphoric
Boracic
Arsenic
Sulphuric
Nitric
Muriatic
Fluoric
Sebacic
Succinic
Formic
Lactic
Benzoic
Acetous Acids
Fixed Alkali
Sulphur
Ox. of Lead

7
BARYT.
In Water.

Sulphuric
Oxalic
Succinic
Fluor
Phosphoric
Lacteo-Saccharine
Nitric
Muriatic
Sebacic
Citric
Tartareous
Arsenic Acids
Formic
Lactic
Benzoic

Acetous

Acetous
Boracic
Sulphureous
Nitrous
Carbonic
Prussic Acids

Fixed Alkali?
Lime?
Water

Fat Oil
Sulphur

In Fire.

Phosphoric
Boracic
Arsenic
Sulphuric
Succinic
Fluoric
Nitric
Muriatic
Sebacic

Formic
Lactic
Benzoic
Acetous Acids

Fixed Alkali

Sulphur

Ox. of Lead

8
STRONTIA.
In Water.

Sulphuric
Oxalic
Tartarous
Fluor
Nitric
Muriatic

Succinic
Phosphoric
Acetous
Arsenic
Boracic
Carbonic
Other Acids?

Fixed Alkalies
Water
Fat Oil
Sulphur

In Fire.

Not ascertained

9
LIME.
In Water.

Oxalic

Sulphuric
Tartaric

Succinic
Phosphoric
Lacteo-saccharine
Nitric
Muriatic
Sebacic

Fluoric
Arsenic
Formic
Lactic
Citric
Benzoic
Acetous
Boracic
Sulphureous
Nitrous
Carbonic
Prussic Acids

Baryt?
Water

Fat Oil
Sulphur
Phosphorus

In Fire.

Phosphoric
Boracic
Arsenic
Sulphuric
Succinic
Fluoric
Nitric
Muriatic
Sebacic
Formic
Lactic
Benzoic
Acetous Acids
Fixed Alkali

Sulphur
Ox. of Lead

10
MAGNESIA.
In Water.

Oxalic

Phosphoric
Sulphuric
Fluoric
Sebacic
Arsenic
Lacteo-saccharine
Succinic
Nitrous
Muriatic
Tartar
Citric?
Formic
Lactic
Benzoic

Acetous
Boracic
Sulphureous
Carbonic
Prussic Acids

Sulphur

In Fire.

Phosphoric
Boracic
Arsenic
Sulphuric
Succinic
Fluoric
Nitric
Muriatic
Sebacic
Formic
Lactic
Benzoic

Acetous Acids

Fixed Alkali

Sulphur

Ox. of Lead

11. 12. 13.
VEG. FOS. AND VOL-ALKALIES.
In Water.

Sulphuric
Nitric
Muriatic
Sebacic
Fluoric
Phosphoric
Oxalic
Tartar

Arsenic
Succinic
Citric
Formic
Lactic
Benzoic Acids
Acetous and Lacteo-saccharine Acids

Boracic
Sulphureous
Nitrous Acids

Carbonic A.

Prussic A.

Water

Fat Oil

Sulphur

Metallic Oxides

In Fire.

Phosphoric
Boracic
Arsenic
Sulphuric
Succinic
Fluoric
Nitric
Muriatic
Sebacic
Formic
Lactic
Benzoic
Acetous Acids

Baryt
Lime
Magnesia
Argill
Silica
Sulphur

14.
WATER.

Veg. Alkali
Fos. Alkali
Vol. Alkali

Alcohol

Carbonate of Vol-Alkali

Æther

Sulphuric A.

Sulphate of Veg-Alkali
Sulphate of Argill
Sulphate of Iron
Oxy-Muriate of Q. Silver
Other compounds, not decomposed by Sulphuric Acid
Silica

15.
SULPHURIC ACID
In Water.

Baryt
Strontia
Veg.-Alkali
Fos.-Alkali
Lime
Magnesia
Vol.-Alkali
Argill
Jargonia?
Metallic Oxides, 20 species
Order in which precipitated

Water

Water
Alcohol

In Fire.

Veg.-Alkali
Fos.-Alkali
Baryt
Strontia
Lime
Magnesia
Jargonia
Metallic Oxides

Vol.-Alkali

Argill

16.
SULPHUREOUS ACID.
In Water.

Baryt

Strontia
Lime
Veg.-Alkali
Fos.-Alkali

Magnesia
Vol Alkali

Argill

Jargonia

Metallic Oxides
Water
Alcohol

17. 18. 19. 20. 21.
NITROUS, NITRIC, MURIATIC, OXY-MURIATIC, NITRO-MURIATIC ACIDS,

In Water.

Veg. Alkali
Fos. Alkali
Baryt
Strontia
Lime
Magnesia
Vol. Alkali
Argill

Metallic Oxides

Water
Alcohol

In Fire.

Baryt
Strontia

Veg. Alkali
Fos. Alkali
Magnesia
Metallic Oxides
Vol. Alkali
Argill

22.
FLUORIC ACID.
In Water.

Lime
Baryt
Strontia
Magnesia
Veg. Alkali
Fos. Alkali
Vol. Alkali
Argill

Metallic Oxides

Silica
Water
Alcohol

In Fire.

Lime
Baryt
Strontia
Magnesia
Veg. Alkali
Fos. Alkali
Metallic Oxides

Vol. Alkali

Argill

23.
BORACIC ACID.
In Water.

Lime

Baryt
Strontia
Magnesia
Veg. Alkali
Fos. Alkali

Vol. Alkali

Argill

Metallic Oxides

Water
Alcohol

In Fire.

Lime
Baryt
Strontia
Magnesia
Veg. Alkali
Fos. Alkali

Metallic

Metallic Oxides
Vol. Alkali
Argill

24. 25.
Oxalic and Tartaceous Acids.
In Water.

Lime
Baryt
Strontia
Magnesia
Veg. Alkali
Fos. Alkali
Vol. Alkali
Argill
Metallic Oxides
Water
Alcohol

26.
Citric Acid.
In Water.

Lime
Baryt
Magnesia
Veg. Alkali
Fos. Alkali
Vol. Alkali
Argill
Metallic Oxides
Water
Alcohol

27.
Benzoic Acid.
In Water.

Lime
Baryt
Magnesia
Veg. Alkali
Fos. Alkali
Vol. Alkali
Argill
Metallic Oxides
Water
Alcohol

In Fire.

Lime
Baryt
Strontia
Magnesia
Veg. Alkali
Fos. Alkali
Metallic Oxides
Vol. Alkali
Argill

28.
Succinic Acid.

Baryt
Lime
Magnesia
Veg. Alkali
Fos. Alkali
Vol. Alkali
Argill
Metallic Oxides
Water
Alcohol

In Fire.

Baryt
Strontia
Lime
Magnesia
Veg. Alkali
Fos. Alkali
Metallic Oxides
Vol. Alkali
Argill

29.
Lacteo Saccharine Acid.
In Water.

Lime
Baryt
Magnesia
Veg. Alkali
Fos. Alkali
Metallic Oxides
Vol. Alkali
Argill

In Fire.

Lime
Baryt
Strontia
Magnesia
Veg. Alkali
Fos. Alkali
Metallic Oxides
Vol. Alkali
Argill

30. 31. 32. Acetous, Lactic, and Formic Acids. *In Water.*

- Baryt
- Veg. Alkali
- Fos. Alkali
- Strontia
- Vol. Alkali
- Lime
- Magnesia
- Argill
- Metallic Oxides
- Water
- Alcohol

In Fire.

- Baryt
- Strontia
- Veg. Alkali
- Fos. Alkali
- Lime
- Magnesia
- Metallic Oxides
- Vol. Alkali
- Argill

33. 34. Sebacic and Phosphoric Acids. *In Water.*

- Lime
- Baryt
- Strontia
- Magnesia
- Veg. Alkali
- Fos. Alkali
- Vol Alkali

- Argill
- Metallic Oxides
- Water
- Alcohol

In Fire

- Lime
- Baryt
- Strontia
- Magnesia
- Veg. Alkali
- Fos. Alkali
- Metallic Oxides
- Vol. Alkali
- Argill

35. Prussic Acid. *In Water.*

- Veg. Alkali

- Fos. Alkali
- Vol. Alkali
- Lime
- Baryt
- Strontia
- Magnesia
- Argill
- Metallic Oxides
- Water

36. Carbonic Acid. *In Water.*

- Baryt
- Strontia
- Lime
- Fixed Alkalies
- Magnesia
- Vol. Alkali
- Argill

- Metallic Oxides
- Water
- Alcohol

37. Arsenic Acid. *In Water.*

- Lime
- Baryt
- Strontia
- Magnesia
- Veg. Alkali
- Fos. Alkali
- Vol Alkali
- Argill
- Metallic Oxides

- Water
- Alcohol

In Fire.

- Lime
- Baryt
- Strontia
- Magnesia
- Veg. Alkali
- Fos. Alkali
- Metallic Oxides
- Vol. Alkali
- Argill

38. Chromitic Acid. *In Water.*

- Fixed Alkali
- Oxide of Lead

Oxide

Oxide of Copper

39.
Molybdenic Acid.

Sulphur
Fixed Alkalies
Absorb. Earths
Metallic Oxides

40.
Tungstenic Acid.

41.
Oxide of Arsenic.
In Water.

Muriatic Acid
Oxalic
Sulphuric
Nitric
Sebacic
Tartaric
Phosphoric
Fluoric
Lacteo-Saccharine
Succinic
Citric
Formic
Arsenic
Lactic
Acetous
Prussic Acids
Vol. Alkali
Fat Oil
Water

Arsenic.
In Fire.

Nickel
Cobalt
Copper
Iron
Silver
Tin
Lead
Gold
Platina
Zinc
Antimony
Sulphuret of Alkali
Sulphur

42.
Oxide of Titanite.
In Water.

Sulphuric
Nitrous and Muriatic Acids
Prussic A.
Oxy-Muriatic
Nitro-Muriatic

Titanite.
In Fire.

43.
Oxide of Uranite.

Sulphuric
Nitro-Muriatic
Muriatic
Nitric
Phosphoric
Acetous
Gallic
Prussic
Carbonic Acids
Sulphur
Water

Uranite.
In Fire.

44.
Oxide of Sylvanite.
In Water.

Nitrous
Nitro-Muriatic
Sulphuric Acid
Sulphur
Alkalies
Q. Silver
Water

Sylvanite.
In Fire.

Q. Silver
Sulphur

45.
Oxide of Manganese.
In Water.

Oxalic
Tartar
Citric
Fluor
Phosphoric Acids
Nitrous
Sulphuric
Muriatic
Sebacic
Arsenic
Acetous

Other

Other Acids

MANGANESE.
In Fire.

Copper
Iron
Gold
Silver
Tin

Sulphuret of Alkali

46.
OXIDE OF NICKEL.
In Water.

Oxalic Acid
Muriatic
Sulphuric
Tartar
Nitric

Sebacic
Phosphoric
Fluoric
Lacteo-Saccharine
Succinic
Citric
Formic
Acetous
Arsenic
Lactic Acids

Arsenic
Boracic
Prussic
Carbonic
Vol. Alkali

NICKEL.
In Fire.

Iron
Cobalt

Arsenic
Copper
Gold
Tin
Antimony
Platina
Bismuth
Lead
Silver
Zinc
Sulphuret of Alkali
Sulphur

47.
OXIDE OF COBALT.
In Water.

Oxalic Acid
Muriatic A.
Sulphuric A.

Tartar
Nitric

Sebacic
Phosphoric

Fluor
Lacteo-Saccharine
Succinic
Citric
Formic
Lactic
Acetous

Arsenic
Boracic
Prussic

Carbonic
Vol Alkali

COBALT.
In Fire.

Iron
Nickel
Arsenic
Copper
Gold
Platina
Tin
Antimony
Zinc
Sulphuret of Alkali
Sulphur

48.
OXIDE OF BISMUTH.

Oxalic A.
Arsenic
Tartar
Phosphoric

Sulphuric
Sebacic
Muriatic
Nitric
Fluor
Lacteo-Saccharine
Succinic
Citric
Formic
Acetous
Prussic
Carbonic
Vol. Alkali

BISMUTH.
In Fire.

Lead
Silver
Gold
Q. Silver
Antimony

Tin

Tin
Copper
Platina
Nickel
Iron
Zinc
Alkaline Sulphuret

Sulphur

49.
OXIDE OF ANTIMONY.
In Water.

Sebacic
Muriatic
Oxalic

Sulphuric

Nitric
Tartar

Lacteo-Saccharine
Phosphoric
Citric
Succinic
Fluoric
Arsenic
Formic
Lactic
Acetous
Boracic
Prussic
Carbonic Acids

Sulphur

ANTIMONY.
In Fire.

Iron
Copper
Tin
Lead

Nickel
Silver
Bismuth
Zinc
Gold
Platina
Q. Silver
Arsenic
Cobalt
Akaline Snlphuret

Sulphur

50.
OXIDE OF ZINC.
In Water.

Oxalic

Sulphuric

Muriatic
Sach. Lactic
Nitric

Sebacic
Tartar
Phosphoric
Citric
Succinic
Fluoric
Arsenic
Formic
Lactic

Acetous
Boracic
Prussic

Carbonic Acids
Vol. Alkali

ZINC.
In Fire.

Copper
Antimony
Tin
Q. Silver

Silver
Gold
Cobalt
Arsenic
Platina
Bismuth
Lead
Nickel
Iron

51.
OXIDE OF IRON.
In Water.

Oxalic
Tartar

Gallic
Sulphuric
Lacteo-Saccharine
Muriatic
Nitric

Sebacic

Phosphoric
Arsenic
Fluor
Succinic
Citric
Formic
Lactic

Acetous
Boracic
Prussic

Carbonic Acids

IRON.
In Fire.

Nickel

Cobalt
Arsenic
Manganese
Copper
Gold

Silver

Silver
Tin
Antimony
Platina
Bismuth
Lead
Q. Silver
Alkaline Sulphuret

Sulphur

52.
OXIDE OF TIN.
In Water.

Sebacic
Tartar
Muriatic
Sulphuric
Oxalic
Arsenic
Phosphoric

Nitric
Succinic
Fluoric
Sachlactic
Citric
Formic
Lactic
Acetous
Boracic
Prussic Acids

Fixed Alkali
Vol. Alkali

TIN.
In Fire.

Zinc
Q. Silver
Antimony
Copper
Gold
Silver

Lead
Iron
Manganese
Nickel
Arsenic
Platina
Bismuth
Cobalt
Alkaline Sulphurets

Sulphur

53.
OXIDE OF LEAD.
In Water.

Sulphuric
Sebacic
Lacteo-Saccharine
Oxalic
Arsenic

Tartaric
Phosphoric
Muriatic
Nitrous
Fluor
Citric
Formic
Acetous
Lactic
Boracic
Prussic
Carbonic Acids
Fixed Alkali
Fat Oil

LEAD.
In Fire.

Gold
Silver
Copper
Q. Silver
Bismuth

Tin
Antimony
Platina
Arsenic
Zinc
Nickel
Iron
Alkaline Sulphuret

Sulphur

54.
OXIDE OF COPPER.
In Water.

Oxalic
Tartaric
Muriatic
Sulphuric
Sach. Lactic
Nitric

Sebacic
Arsenic
Phosphoric
Succinic
Fluoric
Citric
Formic
Acetous
Lactic
Boracic
Prussic
Carbonic Acids
Fixed Alkali
Vol. Alkali
Double Salts
Fat Oil

COPPER.
In Fire.

Gold
Silver

Arsenic

Arsenic
Iron
Manganese
Zinc
Antimony
Platina
Tin
Lead
Nickel
Bismuth
Cobalt

Q. Silver
Alkaline Sulphuret

Sulphur

55.
Oxide of Q. Silver.
In Water:

Sebacic

Muriatic

Oxalic
Succinic
Phosphoric
Arsenic
Sulphuric
Lacteo-Saccharine
Tartar
Citric
Nitric
Fluor
Acetous
Boracic
Prussic
Carbonic Acids

Q. Silver.
In Fire.

Gold
Silver

Platina
Lead
Tin
Zinc
Bismuth
Copper
Antimony
Arsenic

Iron
Sulphuret of Alkali
Sulphur

56.
Oxide of Silver.
In Water.

Muriatic
Sebacic

Oxalic

Sulphuric

Lacteo-Saccharine

Phosphoric

Nitric
Arsenic
Fluor
Tartaric
Citric
Formic
Acetous
Lactic
Succinic
Prussic
Carbonic Acids

Vol. Alkali

Silver.
In Fire.

Lead
Copper
Q. Silver
Bismuth
Tin
Gold
Antimony
Iron
Manganese
Zinc
Arsenic
Nickel
Platina

Sulphuret of Alkali

57.
Oxide of Platina.
In Water.

Æther

Muriatic
Nitric
Sulphuric
Arsenic
Fluor
Tartaric
Phosphoric
Sebacic
Oxalic
Citric
Formic
Acetous
Lactic
Succinic Acids

PLATINA.
In Fire.

Arsenic
Gold
Copper
Tin
Bismuth
Zinc
Antimony
Nickel
Cobalt
Manganese
Iron
Lead
Silver
Q. Silver
Sulphuret of Alkali

58.
OXIDE OF GOLD.
In Water.

Æther
Muriatic
Nitro-Muriatic
Nitric
Sulphuric
Arsenic
Fluoric
Tartaric
Phosphoric
Sebacic
Prussic Acids
Fixed Alkalies
Vol. Alkalies

GOLD.
In Fire.

Q. Silver
Copper
Silver
Lead
Bismuth
Tin
Antimony
Iron
Platina
Zinc
Nickel
Arsenic
Cobalt
Manganese
Sulphuret of Alkali

59.
ALCOHOL.

Water
Æther
Volatile Oils
Vol. Alkali
Fixed Alkali
Sulphuret of Alkali
Sulphur
Muriates
Phosphoric A.

60.
ÆTHER.

Alcohol
Volatile Oils
Water
Sulphur
Phosphorus
Caoutchuc

61.
VOLATILE OIL.

Æther
Alcohol
Fixed Oil
Fixed Alkali
Sulphur
Phosphorus

62.
FIXED OIL.

Baryt
Strontia
Lime
Metallic Oxides
Æther
Volatile Oil
Fixed Alkali
Volatile Alkali
Sulphur
Phosphorus

ERRATA.

Page	Line	
5	19	*For* STRONTHIAN *read* STRONTIA.
		Last line *after* 3,000, *read* its existence is now doubted.
23	22	*After* air, *add* and
	24	*For* resemble *read* resembling.
25	1	*For* is Saltpetre, *read* Saltpetre, is.
26	19	*For* remaining *read* remains.
30	2	*For* thus formed *read* which.
		Last line *for* sulphuretes *read* sulphurets.
31	21	*For* sulpheret *read* sulphuret.
32	2	*Insert* the *before* combustion.
34	17	*For* extremeties *read* extremities.
35	18	*Insert* it *before* becomes.
38	15	*For* mixt *read* moist.
76	21	*For* added *read* being added.
	27	*Instead of a comma after* distilled, *read* with it
79	9	*Insert* the acid is *after* unless.
101	6	*For* are obtained *read* is obtained.
	10	*For* resembles *read* resembled.
104	1	*For* forms *read* form.
108	13	*For* saturated by *read* saturated, and then by
	28	*For* had *read* has.
114	18	*For* low *read* yellow.
115	10	*Dele* a.
120	2	*For* be the same *read* to be the same.
121	2	*For* minis *read* mines.
129	1	*For* access *read* excess.
		For to destroy *read* as to destroy.
	21	*For* fulminginated *read* fuliginated.
132	1	*For* exuvia *read exuviæ.*
134	4	*For* like *read* as.
144	19	*For a period after* Pouzzolana, *insert a semicolon, and dele* is.
188		Last line *for* one of *read* one and.
191	13	*For* 3.1 *read* 3 to 1.
192	7	*For* yields *read* yield.
193	13	*For* fermentations *read* fermentation.
194		Last line *for* syocovia *read* synovia.

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